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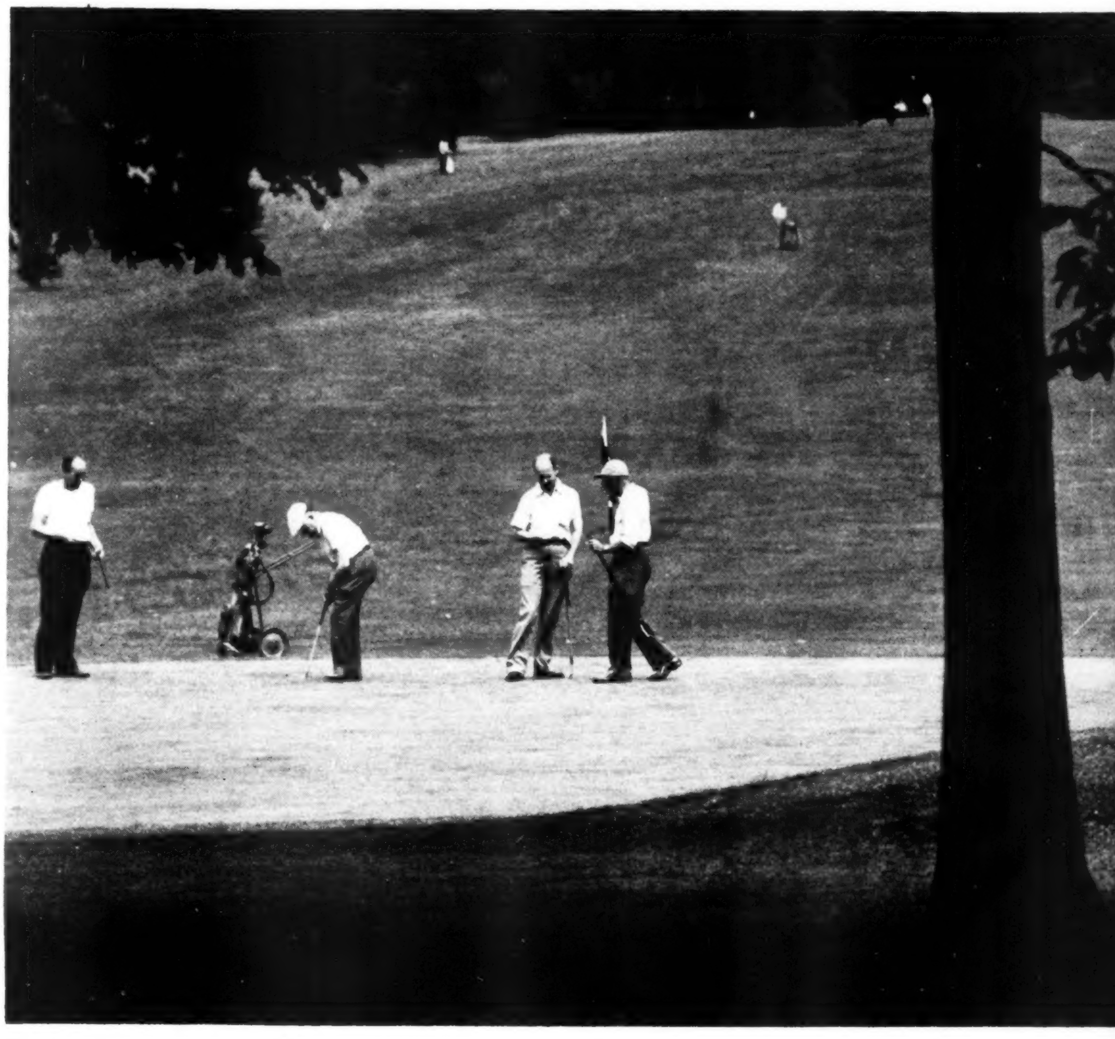


WESTERN SOCIETY OF ENGINEERS FOUNDED 1869

OIL, ARE WE RUNNING OUT OF IT?
WSE MEETINGS—PAGE FOUR

Vol. 3 MAY, 1951 No. 9

You Can't Buy a Thing From This "Salesman"

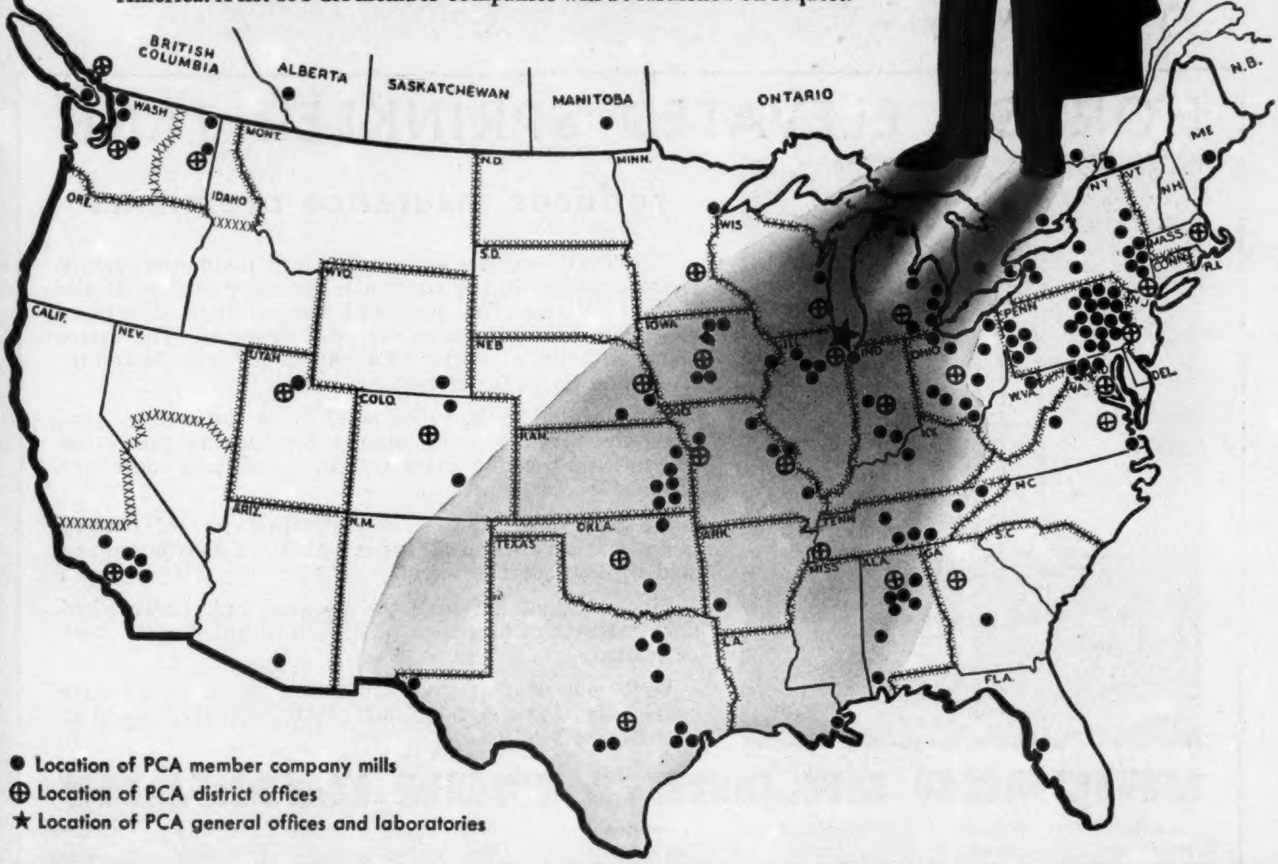
HOW COME? Because the things he "sells" are free. His job is to sell "ideas" and to give technical assistance to cement and concrete users in his territory.

This salesman is one of the 239 field engineers of the Portland Cement Association, operating out of 26 district offices and serving 45 states, who are welcome visitors in thousands of communities.

These field engineers are experts on the uses of portland cement and concrete for all types of construction. Back of them is a headquarters organization of 134 technical specialists and research scientists who provide the up-to-the-minute information and technical literature which enable the PCA field engineer to give maximum service, without charge, to cement users—large and small—thus insuring to them best results from their concrete dollar.

The broad program of research, development and engineering service conducted by the Portland Cement Association is made possible by the financial support of its 67 member companies engaged in the manufacture of portland cement throughout the United States and Canada.

The PCA is a non-profit organization dedicated to improving and extending the uses of portland cement and concrete so that these materials may play their proper role in improving the standard of living of all America. A list of PCA member companies will be furnished on request.



● Location of PCA member company mills
⊕ Location of PCA district offices
★ Location of PCA general offices and laboratories

PORTLAND CEMENT ASSOCIATION

33 WEST GRAND AVENUE, CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work

General and Editorial Offices
Headquarters of
Western Society of Engineers

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Chicago 1, Illinois
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Midwest Engineer
Published Monthly
except June, July, August by
THE WESTERN
SOCIETY OF ENGINEERS
at
2207 Dodge Avenue
Evanston, Illinois

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Single copy .... $ .35
Annual subscription 3.00
Foreign subscription 4.00

Entered as second-class matter September 23, 1948 at the post office at Evanston, Illinois under the Act of March 3, 1879.

MIDWEST ENGINEER

A Publication of the

WESTERN SOCIETY OF ENGINEERS

Serving the Engineering Profession

May, 1951 CONTENTS Vol. 3, No. 9

COVER CREDIT

A Shot of Last
Year's Golf Tournament
At Nordic Hills
Country Club.

this month at WSE

COMING EVENTS OF INTEREST TO ALL MEMBERS

May 7, Chicago Area Power System

SPONSORED BY THE ELECTRICAL SECTION

Titus LeClair

Problems of planning and designing a large metropolitan power system will be explained when **Titus G. LeClair** speaks on the "Chicago District Power System," May 7, at WSE headquarters.

Mr. LeClair, a past president of the Western Society, is chief electrical engineer of the Commonwealth Edison Company. His talk will include the expansion program of the Commonwealth Edison Company and its subsidiary, the Public Service Company of Northern Illinois.

Mr. LeClair's presentation will outline the problems of the gigantic Chicago area system, which covers an 11,000 square miles of territory and serves 5,500,000 people. He will describe briefly some of the major generating and transmission projects in this expansion program which has added 514,000 kilowatts of generating capacity since the close of World War II, and includes an additional 920,000 kilowatts of capacity in various stages of construction.

This Chicago power system talk will be illustrated with slides.

May 12, Tour New Filtration Plant

WSE members and their families are invited on an inspection of Evanston's new filtration plant, Saturday, May 12, at 10 a.m.

The most recent filtration plant built in the Chicago area, the Evanston works was completed in 1950. It is the rapid sand filter type, with a capacity of 24 million gallons per day, filtering the entire water supply for the city of Evanston.

This excursion is limited to WSE members and families. Excursioners are asked to bring their WSE membership cards for identification because of rigid security measures the plant employs.

Evanston's filtration plant is located on Lincoln Street, East of Sheridan Road, north of Patten Gymnasium of the Northwestern University campus. Persons not driving should get off the Evanston elevated at Noyes St. station, and walk east to the Northwestern campus.

Call Ra 6-1736 for reservations.

May 14, Engineer's Part in Government

SPONSORED BY THE COMMUNICATIONS SECTION

Engineers are fast becoming important advisors on Congressional legislation, and the man who should know about such things, **Francis X. Welch,** will be at headquarters, May 14, to tell WSE about "The Engineer's Place in Washington."

Mr. Welch, managing editor, "Public Utilities Fortnightly," and Washington editor, "Telephony," is an able analyst of political affairs, plus a possessor of a broad engineering background. He intends to point out the increasing importance of engineering advice on various legislation which Congress must consider, such as public project work. Mr. Welch will also refer to the necessary engineering function in regulatory commission proceedings, and will touch on the current emergency control work.

In addition, Mr. Welch plans a general "back of the scenes" discussion of the Washington merry-go-round, and expects to answer many questions.

May 21, Food and Farming Processes

SPONSORED BY THE CHEMICAL-METALLURGICAL SECTION

The Chemical and Metallurgical Section is planning an outstanding session for this the last general meeting of the year. **Dr. W. L. Faith,** director of engineering, Chemical Division, Corn Products Refining Co., will speak on "Process Developments in the Food and Agricultural Industries."

June 4, Annual June Dinner Meeting

WSE's top event of the year will be held on June 4, at the Furniture Club of America, 667 N. McClurg Court, with fellowship at 5:30 p.m. and dinner at 7 p.m.

On the agenda for the annual dinner will be a review of the past year and the introduction of the 1951-52 officers, by **Mr. H. P. Sedwick.** The new president will announce his committee appointments, present the service and prize paper awards and introduce the new life members.

Highlighting the evening will be the main speaker **Mr. H. N. Muller,** assistant to the vice-president in charge of engineering, Westinghouse Electric Corporation. Aside from his numerous staff and committee assignments for Westinghouse, Mr. Muller has direct responsibility for the Educational Department, the Materials and Standards Engineering Department, the Liaison Engineering Department, the Foreign Engineering Department and the Engineering Association Activities. The subject of Mr. Muller's talk will be "Memo to Engineers."

July 20, Second Golf Tourney

NORDIC HILLS COUNTRY CLUB

See details in this issue.

Don't Miss the Highlight of WSE's Year!

ANNUAL JUNE DINNER

JUNE 4, 1951

H. N. Muller, Speaker

ENGINEER, EDUCATOR, INDUSTRIAL LEADER

Assistant to the Vice-President In Charge of Engineering
Westinghouse Electric Corporation

On A "Memo to Engineers"

FURNITURE CLUB OF AMERICA
667 NORTH McCLURG COURT, CHICAGO
FELLOWSHIP — 5:30 P.M. DINNER — 7 P.M.

Review of 1950-51

Introduction of New Officers

Announcement of Contest Winners

Presentation of Awards

Introduction of New Life Members

For Choice Tables Return this Reservation Blank

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OIL,

are we running out of it?

Prepared for
the MIDWEST ENGINEER

By

DR. GUSTAV EGLOFF
Universal Oil Products Co.

TABLE I
WORLD CRUDE OIL PRODUCTION
(Thousands of barrels, daily average)

	1940	1950
NORTH AMERICA		
United States	3,697.3	5,325.4
Canada	23.5	77.0
Mexico	120.4	200.0
Total	3,841.2	5,602.4
SOUTH AMERICA		
Venezuela	508.0	1,496.0
Colombia	69.8	93.0
Argentina	56.5	63.0
Trinidad	60.8	56.3
Peru	33.1	40.3
Ecuador	6.4	7.2
Bolivia	0.8	1.7
Cuba	0.3	0.3
Brazil	——	1.0
Chile	——	1.6
Total	735.7	1,760.4
W. HEMISPHERE	4,576.9	7,362.8
EUROPE		
Roumania	108.0	85.0
Austria	7.7	23.0
Germany	20.2	21.6
Hungary*	3.0	10.0
Poland*	10.7	2.5
Netherlands	——	13.8
Albania*	2.5	5.8
France	1.4	2.9
French Morocco	——	0.8
United Kingdom	0.3	0.9
Czechoslovakia	0.2	0.8
Yugoslavia	——	6.5
Italy	0.2	0.2
Total	154.2	173.8
U.S.S.R.	603.0	754.0
Total	757.2	927.8
NEAR AND MIDDLE EAST		
Iran	181.0	661.0
Saudi Arabia	13.9	548.0
Iraq	66.4	137.0
Kuwait	——	343.0
Bahrein	19.3	30.2
Qatar	——	34.0
Egypt	17.8	44.5
Turkey	——	0.8
Total	298.4	1,798.5
FAR EAST AND OCEANIA		
Indonesia	170.0	139.0
British Borneo	19.3	83.0
New Guinea	——	4.8
India	28.0 (India, Pakistan, Burma)	5.5
Pakistan		3.2
Burma		1.5
Japan	7.3	5.4
China	——	2.0
Total	224.6	244.4
E. HEMISPHERE	1,280.2	2,970.7
WORLD TOTAL	5,857.1	10,333.5

*1939

Petroleum and natural gas supply hydrocarbon fuels which are vital to modern civilization. The production and refining of these two mineral fuels are the business of the oil industry. By far the greater part of petroleum appears on the market as liquid fuels. The industry furnishes enormous volumes of motor fuels, aviation gasoline and liquefied petroleum gases for motor vehicles and heating, and middle distillates for diesel engines and space heating. Residual fuel oils are used in marine vessels and in stationary power plants. In the last ten years, the use of petroleum as a source of energy has been increasing at an average rate of 4 per cent a year, while the use of natural gas has been increasing at the rate of 10 per cent a year. As a result of increasing demands, the question is frequently raised whether we are assured of adequate supplies for the forseeable future, and cries of oil shortage are heard periodically. At none of these times has there been a real shortage of oil except in the minds of those making scare-head statements about it. Whenever increased supplies have been needed, the oil industry has always met demands by increased production of crude oil and refined products, and it will continue to furnish necessary quantities for peace or war. No one is so well aware of the situation in oil requirements and supplies as the oil industry itself. The industry is a highly competitive one and as long as our incentive system continues it will furnish oil products for our every need.

Oil Industry Growth

The oil industry on which our modern industrial structure and our transportation systems are so dependent has been an amazing development of the last ninety-two years. Prior to 1859, a few thousand barrels of oil had been produced in Roumania from hand-dug wells, and small amounts had been skimmed from the surfaces of streams and rivers in the Pennsylvania mountains. The big market up to about 1900 was kerosene for lamps to substitute for whale oil. In 1880, the yield of kerosene from our crude oils was 75 per cent. The fractions of crude petroleum which could not be used as kerosene were burned in pits or dumped into rivers to plague the countryside. The gasoline was burned or vented into the atmosphere as there was practically no demand for it. The kerosene age continued until the advent of the automobile around the turn of the century, at which time the U. S. annual production of crude petroleum was about 63 million barrels, about 43 per cent of world output of 149,137,000 barrels in 1900. At this time, the yield of kerosene had dropped to 30 per cent.

The automobile created a demand for

the gasoline. By 1910, U. S. production of crude oil had risen to about 210 million barrels, but the production of gasoline was only about 17 million barrels or 8 per cent of the crude oil. The gasoline was all straight-run since the cracking process for making gasoline had not yet been used by the industry. In the next decade, the demand for gasoline began to be a highly important factor in our economy because of the increasing number of automobiles. Production of crude petroleum more than doubled, reaching 443 million barrels in 1920. In that year, 124,120,000 barrels of gasoline were produced, representing 28 per cent of the crude oil. Since 1920, the demand for gasoline and other motor fuels has been a primary influence on the growth of the petroleum industry.

The two world wars which have occurred since 1900 have given added impetus to petroleum production and refining, and in 1950, the U. S. output of petroleum was 1,943,776,000 barrels, and of natural gas liquids, 227,411,000 barrels, making a total production of 2,171,187,000 barrels of hydrocarbon liquids. World production for this year was about 3,810,000,000 barrels of petroleum. The volume of petroleum produced annually in the United States increased thirty-five times in the first half of the twentieth century and world production increased twenty-five times. Demand for products from petroleum and natural gas continues to rise steeply as national economies become industrialized.

Table I shows the production of petroleum by countries and areas in 1940 and 1950. The data in the Table show that the rate of production for the world as a whole has increased 77.8 per cent in the last ten years. The production rate in the United States in this interval increased 46.1 per cent. The greatest influence during this period has been the rapid increase in production in the Middle Eastern countries. A Russian geologist who left the U.S.S.R. in 1942, a Mr. Smirnov, is of the opinion that Russia is not publishing exact figures on her oil production and that the production of 754,000 barrels a day shown in Table I is too low. He estimates that the U.S.S.R. is now producing between 828,000 and 888,000 barrels of petroleum daily.

Investments

At the end of 1950, the petroleum industry in the United States was employing gross assets of over 33 billion dollars. This included 23.5 billion representing gross value of plant, property and equipment, 6.3 billion in current assets and 4 billion of other assets. Capital expenditures were close to 2.2 billion in 1950, and the projected expenditure for 1951 is 2.4 billion. Expansion of facilities in all branches since the war has cost over 10 billion dollars, and has gone for exploration, production and plant modernization and expansion of producing, refining and marketing facilities. A number of oil companies are heavy investors in foreign fields particularly in Venezuela, Canada and the Middle East.

Energy Sources

Petroleum, natural gas and natural gas liquids are playing a rapidly increasing role in supplying our nation's energy requirements. Table II shows that from 1900 to 1949, U. S. total energy consumption increased from 8,000 to 32,000 trillion b.t.u's per year. In the same interval, the percentage of our energy supplied by oil increased from 4.7 to 36.6 while the percentage supplied by natural gas increased from 3.2 to 18.7. During the same time, the percentage of energy supplied by coal decreased from 88.9 in 1900 to 39.8 in 1949. Since 1930, the actual energy supplied by coal has decreased over 10 per cent while that supplied by oil has increased about thirty times and that supplied by natural gas about twenty-five times. The decrease in the percent of energy supplied by coal is more striking since it has dropped from 62.5 in 1930 to 39.8 in 1949. Decline in coal consumption has resulted from unreliable supplies because of labor difficulties, decline of exports because of a revival of European coal mining, conversion of steam locomotives to diesels and change from coal to oil fuel by electric utilities. These losses amounted to about 100 million tons of coal a year from 1947 to 1949.

Consumption of Petroleum Products

The United States has the highest per capita consumption of petroleum of any country or world area. Table III gives data in support of this fact. The population figures for areas other than the United States are partly estimated. The Table shows that the per capita annual consumption of petroleum in the United States is 15.5 barrels (1 bbl. = 42 gallons) compared with 1.62 barrels for the world as a whole and 0.655 barrels for the world outside of the United States. The per capita annual consumption of 1.25 barrels for Russia and her satellites is based on the assumption that all their domestic oil production is consumed at home.

(*Continued on Page* 8)

TABLE II

U. S. ENERGY USES

	Coal		Oil		Natural Gas		Water Power		
Year	BTU'S[1]	% of total	BTU'S[1]	% of total	BTU'S[1]	% of total	BTU'S[1]	% of total	Total
1900	7,020	88.9	369	4.7	254	3.2	250	3.2	7,893
1910	13,074	85.0	1,218	7.9	547	3.6	539	3.5	15,378
1920	17,175	78.2	3,175	14.5	858	3.9	738	3.4	21,956
1930	14,011	62.5	5,568	24.8	2,089	9.3	752	3.4	22,420
1940	13,380	53.1	8,096	32.1	2,860	11.3	880	3.5	25,216
1949	12,557	39.8	11,572	36.6	5,899	18.7	1,539	4.9	31,567

[1]Trillions

TABLE III

CONSUMPTION OF PETROLEUM

Area	Population	% of total	Oil Consumed Bbls. per year	% of total	Bbls. per capita
World	2,341,000,000	100.00	3,800,000,000	100.00	1.62
U.S.A.	153,000,000	6.53	2,375,000,000	62.50	15.50
Outside U.S.A.	2,188,000,000	95.47	1,425,000,000	37.50	0.655
Russia and Satellites	260,000,000	11.10	325,000,000	8.55	1.25

Motor Vehicles

The relatively high consumption of petroleum products in the United States is accounted for by its highly developed industrial and transportation systems. The United States now has a total of more than 48 million motor vehicles on its highways which consume around 2,800,000 barrels of motor fuel daily. Table IV gives a tabulation of the average number of passenger cars, trucks and buses in use in years from 1900 to 1950 and an estimate for 1951. The automotive vehicles on our highways are now about 70 per cent of the world total which is approximately 70 million.

The total installed horsepower of automotive vehicles dependent upon gasoline for fuel is over 3 billion. In 1950, the output of gasoline for our motor vehicles was 973,262,000 barrels.

Airplanes

The United States also leads in the development of airplane transportation. On December 31, 1940, we had 17,928 registered civil aircraft while on December 31, 1950 we had 92,809. The comparative figures for commercial airliners on these same dates were 437 and 1,199. The commercial airliners are included in the figures for total aircraft and include scheduled U. S. and foreign service airliners. We also led in airplane production and airplane fuel supply in World War II. A peak production of 600,000 barrels a day of aviation gasoline in the United States was reached in October 1944. In 1950, our daily average production of all grades of aviation gasoline was 140,000 barrels.

Locomotives

The use of diesel engines in railroad transportation is expanding rapidly as shown in Table V which gives the classification of locomotives in 1939 and 1949. In the decade for which initial and final figures are given, diesel electric locomotives increased from 510 to 10,888, a twenty fold gain. On March 1, 1950, 98 per cent of all locomotive orders were for diesels, and diesel locomotives are now doing half of the yard and passenger train hauling and more than a third of the freight service. It is anticipated that about 85 to 95 per cent of railroad transportation will be handled by diesel engines in 1960. At the present time, our railroads are using about 25 per cent of our coal production and 7 to 7.5 per cent of our petroleum output. All of the coal and some of the oil are used as fuel for steam locomotives, the remainder of the oil being employed in diesel electric units. If the railroads were completely dieselized, they would use none of the coal and only about 5.5 per cent of our petroleum production because of the 30 per cent efficiency of diesel units compared to 5 to 10 per cent for steam locomotives. The actual annual savings would be about 150 million tons of coal and 40 million barrels of oil, both of which items are worth considering.

Extensive studies have been made of the relative operating cost of coal-burning steam, and oil-powered diesel-electric locomotives. Records of actual operating costs show that the diesel locomotives cost 60 per cent as much as the steam-driven type.

Trucks, Buses and Tractors

In 1940, there were not more than 1600 trucks and buses with diesel engines, while in 1950, there were an estimated 50,000 of such diesel-powered units.

Increasing use is also being made of liquified petroleum gases, and particularly liquid propane, as fuel for buses and trucks. The Chicago Transit Authority has contracted for a supply of 700,000 barrels of propane for the next five years to fuel 500 new buses. A taxi company in Milwaukee, Wisconsin has announced its intention of operating 280 cabs on propane after satisfactory test runs. Propane is also being used in Ohio and in Texas for bus operation. Large numbers of both trucks and buses are using liquefied petroleum gas as motor fuel in California.

Farm tractors are not included in the registered motor vehicles since they are not used on highways. In the United States, prewar there were 1,885,000 farm tractors whereas the latest available survey made in 1949 indicated 3,500,000, an increase of nearly 100 per cent in ten years. The farm tractors of Great Britain have increased at a still higher rate. In 1939, there were 55,000 while in 1950 there are over 300,000.

TABLE IV

U. S. AUTOMOTIVE VEHICLES IN USE

Year	Busses and Trucks	Passenger Cars	Total
1900	———	8,000	8,000
1910	10,123	458,377	468,500
1920	1,107,639	8,131,522	9,239,161
1930	3,559,254	22,972,745	26,531,999
1940	4,683,376	27,240,475	31,923,851
1950	8,481,000	38,042,000	46,533,000
1951, Est.	8,965,000	40,855,000	49,820,000

Space Heating

The use of petroleum distillates for space heating is also undergoing rapid expansion. Prewar, the United States had 2,402,000 domestic oil burning furnaces (central heating units), and 2,220,000 space heaters (portable stoves). Corresponding figures for 1949 were 4,490,000 and 6,100,000. In 1940, we consumed 160,379,000 barrels of heating oil in domestic use. In 1950, consumption was 373,000,000 barrels, more than a two fold increase.

Shortage Scares

The subject of petroleum resources over the years has been extremely controversial. As early as 1874, when the U. S. industry was only fifteen years old, gloomy predictions were made by Pennsylvania's State Geologist that we only had enough petroleum to keep our kerosene lamps burning for about four years. Since that time, fears of shortages have been voiced periodically. In 1908, the Director of the U. S. Geological Survey declared that U. S. ultimate reserves of petroleum could not possibly amount to more than 24.5 billion barrels. From 1859, through 1907, less than 2 billion barrels of petroleum had been produced in the United States. However, since 1908, 39 billion barrels of oil have been produced, and in addition our proved reserves of liquid hydrocarbons at the end of 1950 totaled over 30 billion barrels.

A shortage scare occurred in 1916 when model "T" Ford cars were first in mass production. Nearly 2,500,000 automobiles were on the road in 1915 and car production had reached one million annually. The bringing in of the Cushing oil field in Oklahoma temporarily overcame fears of gasoline shortage, but the flush production only lasted about a year and the worries about shortage returned in 1916. During the hysteria of this supposed petroleum shortage, attempts were made to place prohibitive export taxes on gasoline, to place an embargo on petroleum products, to regulate the oil industry and to have the government drill on government-owned lands. However, before 1916 ended new fields were discovered in the Mid-continent area and in California, and the cracking process eased the supply situation so that this shortage scare disappeared in 1917. In May, 1920, the United States geological survey estimated that there were only 7 billion barrels of oil available in the United States and Alaska. During this scare, the return of the horse was predicted in fifteen or twenty years, whereas exactly the opposite has taken place. In 1920, there were nearly 20 million horses on farms in the United States and about 500,000 on roads. By 1950, our total horse population decreased to 5½ million, while automotive vehicles have risen from 9 to 46 million. (See Table IV.) The rising price of crude oil stimulated exploration and the apparent shortage was soon eliminated by new oil discoveries. None of these scares was founded on fact, and supposed shortages were promptly wiped out by the production of oil from reserves and newly discovered fields.

TABLE V

RAILROAD LOCOMOTIVES

Year	Steam	Electric	Diesel Electric	Total
1939	41,117*	843	510	42,470
1949	28,964	817	19,888	40,669

*Including both coal and oil burning.

The Search for Oil and Gas

The industry has always met increasing demands for its products by intensified exploration and production and maintains the ratio of proved reserves to production at a safe figure. The price of crude oil has undergone wide variations according to supply and demand. The highest price paid per barrel was $20.00 in 1859. In January 1860, Pennsylvania oil sold at an average price of $19.25 a barrel but continuing overproduction dropped the price to 10 cents a barrel in the last three months of 1861. During the period of flush production in East Texas in 1931, a 50,000 barrel lot of oil sold for 2½ cents a barrel, the lowest recorded price. At present, the average price of crude oil is $2.57 a barrel though it ranges from $2.00 to $4.00 a barrel, depending upon the quality of the crude. The price of crude oil has a marked effect on exploratory drilling. For example, with crude oil priced at an average of $1.18 a barrel in 1938, only 2,443 wildcat wells were drilled, while in 1950, with crude oil at an average price of $2.57 per barrel, there were 7,780 wildcat wells.

To assure continued adequate supplies extensive exploration is being conducted in the United States proper and in many other parts of the world where we have exploratory and producing agreements. United States' oil finding is particularly active in Venezuela, Canada and in the Middle East.

The United States has been more thoroughly explored than the world's other potential areas, even though some geologists have stated that less than one per cent of U. S. possible oil bearing areas have been "thoroughly explored by the drill." In the United States, it

(*Continued on Page 23*)

TABLE VI

U. S. ANNUAL PRODUCTION AND PROVED RESERVES OF PETROLEUM
(Thousands of barrels)

Year	Production	Net Reserves added during year	Reserves at end of year	Ratio Reserves/ Production
1859-1899	939,983	———	2,500,000	43.8*
1900	63,621	400,000	2,900,000	45.6
1910	209,557	300,000	4,500,000	21.5
1920	442,929	500,000	7,200,000	16.3
1930	898,011	400,000	13,600,000	15.1
1940	1,351,847	541,503	19,024,515	14.1
1950	2,171,187	1,157,560	29,536,061	13.6

*Based on 57,071,000 bbls. production in 1899

A SOLUTION TO HIGHWAY PROBLEMS . . .

TOLLWAYS

By Charles E. De Leuw
President, De Leuw, Cather
Presented Before WSE,
April 2, 1951

You engineers who are interested in highways are faced by a prodigious task. It has been estimated that the current backlog of needed highway work would require the expenditure of from 40 to 60 billion dollars. This is a careful estimate based on detailed studies in a number of states. At the 1950 rate of 1½ billion dollars for highway construction, the work at hand would require more than 25 years to complete, by which time we would probably be even farther behind.

At least one per cent of the mileage of highways in this country, or approximately 30,000 miles, would justify their development as controlled access highways. There are at present less than 1,000 miles of this type of highways in the country and nearly a third of this is in urban areas. Access is partially controlled on an additional 900 miles. It appears, then, that the young engineer in the highway profession is not in serious danger of working himself out of a job.

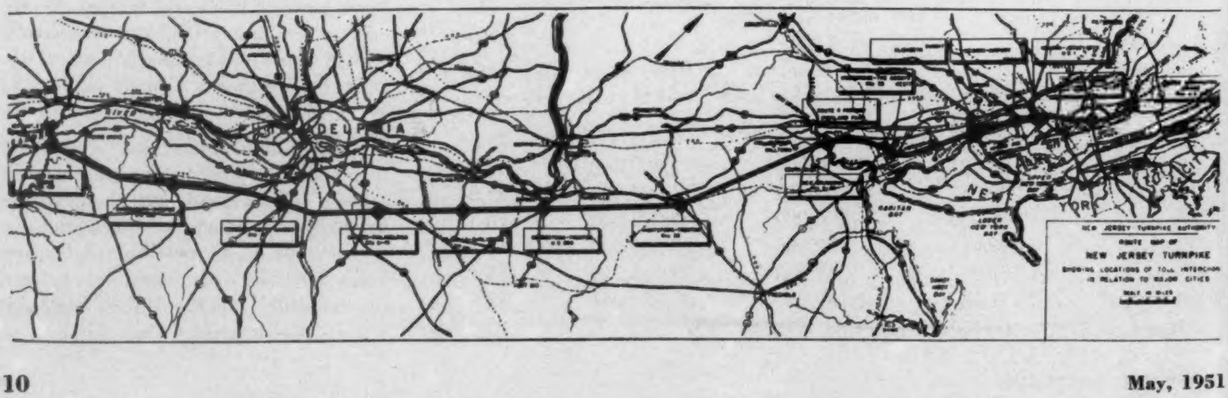
The financial aspects of the problem are inseparable from those dealing more intimately with the steel and concrete. We are failing to build highways fast enough, not because of any shortage of engineering talent, labor, or materials, but primarily because there is a shortage of dollars.

The present interest in toll roads reflects a willingness on the part of the traveling public to pay for highways of the best design that modern engineering practice has been able to develop. The outstanding success of the Pennsylvania Turnpike and the Merritt Parkway in Connecticut has led to the creation of authorities in other states to finance, build, maintain and operate toll roads. Turnpike authorities in Maine and New Hampshire have completed such projects. New Jersey, Oklahoma and Colorado now have turnpikes under construction.

Financing

Revenue bond financing has proven to be entirely practicable for self-liquidating projects. The service charges on the revenue bonds issued by the authority are met through payments from the net revenues from tolls. The bonds do not constitute a debt of the state and have no effect on general taxes. In most instances no portion of motor fuel taxes or license fees is pledged. The revenue bonds are sold on the basis of engineering reports: one covering traffic

Route map of New Jersey Turnpike, beginning at the right at the George Washington Bridge, New Jersey side, traveling southward, bypassing Newark, Trenton, Philadelphia and other traffic-bound towns, and ending at Wilmington, Delaware.



Aerial perspective of a typical turnpike traffic interchange.

and revenues and the other covering location, preliminary design and estimated construction costs. Included in the reports are estimates of annual maintenance and operating expenses.

Variations in revenue bond financing have been considered and, in some cases, adopted. One method is the issuance of bonds to be retired from future motor vehicle revenues of the various cities and states and future federal appropriations for highway purposes. The City of Detroit proposes to sell $100 million worth of revenue bonds to be retired in this manner to speed construction of its urban expressways. The rather novel legislation recently passed in Pennsylvania is also of interest. This permits public authorities to build roads or bridges for rental to the State Highway Department at rates sufficient to amortize the investment. The New York State Department of Public Works is proposing a special motor vehicle tag for those who wish to use the New York Thruway as an alternate to the more expensive system of collecting tolls for each individual trip.

In addition to making construction funds available, the toll road method of financing opens opportunities for engineers to build roads which would otherwise face insurmountable administrative difficulties. The public highway official meets political objections to spending large portions of motor vehicle revenues on routes between the larger cities in his state, because most legislatures are predominantly rural in make-up. So far, highway officials have had little acceptance of their arguments that such routes are vital as main stems in the farm-to-market routes. The farm vote is more interested, it seems, in the roads within their respective townships. Likewise, it is politically inexpedient to concentrate sufficient funds in one portion of a state to complete a useful length of a controlled access road within a short period of time. These problems are not to be passed over lightly, however selfishly inspired they might seem to be.

The engineering phases of toll roads differ little from the steps that should be taken in connection with the planning, construction and operation of any major interregional highway. Both free and toll roads should be economically sound and competently designed for present and future volumes of traffic.

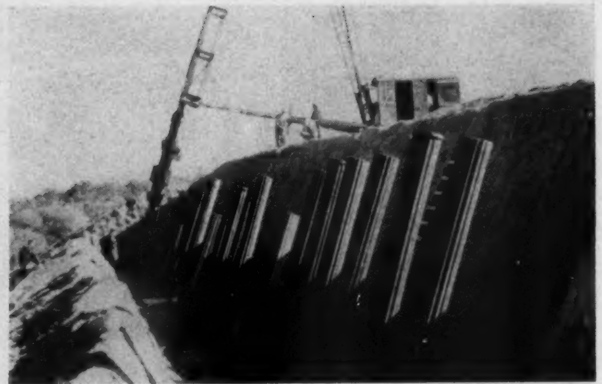
These engineering phases may be divided into four parts as follows:

Traffic and revenue studies,
Preliminary location and design,
Design and construction, and
Operation.

(*Continued on Page* 12)

Lower left: Excavating equipment on New Jersey Turnpike. Output of grader has exceeded 1500 cubic yards per hour.

Lower right: Skeleton of highway bridge over N. J. Turnpike. Design is based on simplicity, economy and serviceability.



Above left: Typical New Jersey Turnpike bridge over local highway. Uniformity means economy and speed. Above right: File driver at edge of embankment on N. J. Turnpike, working on fill placed and consolidated less than three weeks.

Traffic and Revenue Studies

It is usually not feasible to make a controlled access highway out of an existing highway. The cost of condemnation of roadside improvements, plus the purchase of rights of access for other owners of abutting property, mounts to an almost prohibitive figure. In addition, the existing road is usually necessary to serve local traffic. It is customary, therefore, in planning modern rural highways, to think in terms of acquiring a completely new right-of-way in a location most appropriate to serve the needs of traffic and at the same time one which will be practicable from the construction standpoint.

Traffic studies are needed to determine if a proposed highway would attract enough vehicles to justify construction. It is also necessary to know if a similar highway on one or more alternate alignments would be useful to perhaps even more traffic. Furthermore, we must estimate how many vehicles will use the highway, both immediately after completion and 20 or 30 years in the future, so that all features will provide adequately for such volumes.

The customary way of arriving at the answers to these questions is to make origin and destination studies. In these studies we interview the drivers of essentially all vehicles presently using highways within the probable zone of influence of the proposed new route. Such surveys generally continue over a period of seven consecutive days. If the traffic in the area is subject to wide seasonal fluctuations, it may be essential to have such origin-destination studies at different seasons of the year.

In order to decide whether or not an individual would be willing to patronize the proposed new toll highway in going from a specific origin to a specific destination, it is necessary to know what difficulties he encounters on the route he is now using. The most tangible of these difficulties can usually be reduced to the time required for traveling. Thus, running time studies are made covering every highway of any importance within the entire region from which traffic might be drawn to a new turnpike. These studies must be made at various times of the day and night and on different days of the week. If the travel time of trucks is considerably different from that of private automobiles, these running times must also be determined. There are many techniques for doing this and one must be selected which is most appropriate to conditions.

The Highway Planning Survey offices of the various state highway departments usually have an invaluable store of data on traffic volumes on various highways in the vicinity of proposed turnpikes. Most important of these are the counts at the permanent stations which cover all seasons so that the surveys can be adjusted to represent a full year's traffic. In addition, classification counts must be made at various points to determine the portion of the total traffic that will fall into each group in the proposed toll schedule. It is desirable to have such classification counts in the different seasons of the year since it is always questionable, on each project, whether commercial traffic rises and falls with the total traffic, or whether it represents rather constant volumes and the fluctuations are accounted for by tourist travel.

It is also necessary to know how much traffic on the minor crossroads might be inconvenienced if overpasses or underpasses were not provided at such locations. Since it is economically unsound to build grade separations on all existing crossroads, an effort is made to close those which are least important. There must also be a reasonable spacing between points at which the turnpike right-of-way can be crossed.

An allocation of the surveyed traffic to a proposed road is based largely on the old axiom TIME IS MONEY. We estimate the time that each group of vehicles would save in going between each pair of origins and destinations. If the toll charge in a specific instance would be less than the value of the time that would be saved, we allocate an appropriate portion of that traffic to the proposed toll road. The larger the time saving for any given toll, the larger is the percentage of traffic allocated for that pair of zones.

We know that other factors of toll roads besides potential time savings have value. Such attributes as safety, driving ease, and attractive surroundings, for example, are more important

(*Continued on Page* 13)

Tollways

(*Continued from Page* 12)

to many people than the few minutes that might be saved by using a toll facility. Proof of this is the leisurely way in which people stop along our existing toll roads to lunch, buy souvenirs, or enjoy the beauties of nature. Since these values are indeterminate, however, we assume that all attractions are reflected in time savings and base our estimates of potential traffic on this demonstrable factor alone.

In addition to the revenues obtainable from tolls, it is a conservative assumption that approximately five per cent additional revenue can be obtained from the rental of concessions along a toll road.

Preliminary Location and Design

Field investigations of potential routes are preferably carried on simultaneously with the making of traffic studies. If there appears to be more than one feasible route on alignments varying enough to affect traffic volumes, separate allocations of traffic should be made to each of the alternate routes.

It is also necessary at this point to decide tentatively where points of access will be provided. Subsequent allocation of traffic then determines whether or not the traffic tributary to a possible interchange is sufficient to make the construction and operation of that toll plaza economically sound.

In addition to attractiveness to potential users, the preliminary location must give consideration to probable right-of-way cost, construction problems and conformance with the adopted standards for alignment and grade.

Investors in revenue bonds usually prefer that one firm of consulting engineers make the estimates of traffic and revenues, while a different firm prepares preliminary designs and estimates of cost. This is to reduce the chance of subconscious tendencies to raise the allocations of traffic to the levels necessary to meet known estimates of cost, or to keep the estimates low to conform with predicted volumes of traffic.

At some period in the undertaking, however, the two organizations must work in close coordination, either under the engineers of the turnpike authority, or under the direction of an overall consultant. If the first estimates of each group, when brought together, do not indicate a financially feasible project, ways must be found, if possible, to attract more traffic, prepare a less costly design or reduce operating expenses.

The functional design of a highway can vary within wide limits, depending on the potential revenue, and still be adequate to compete successfully with existing free roads. The minimum standards are that two or more 12-foot lanes be provided for traffic moving in each direction; that the two roadways be separated by a central mall; that adequate all-weather shoulders be provided; that vertical and horizontal clearances be ample; that minimum sight distance and curve radii and also maximum gradients be such as to permit speeds of 70 m.p.h. and all cross traffic be carried over or under the turnpike.

Preliminary Engineering as a Basis for Toll Roads

Preliminary engineering as a basis for toll road financing must be done with more than the usual care since this includes estimates of rights-of-way and construction cost and the preparation of a construction program. These estimates become the foundation for the issuance of revenue bonds and if the funds prove to be inadequate, or if the period of construction develops to have been too optimistically determined, the project may be in financial difficulties before it is ever opened to traffic. For these reasons, liberal allowances are usually made for contingencies to provide an adequate factor of safety—not as a substitute for painstaking and expert engineering work.

Design and Construction

The primary difference between the typical highway job and a toll road constructed for an authority is that in the latter case time is money to the authority no less than to its patrons. On the Oklahoma Turnpike, for example, with $31 billion in bonds outstanding, every calendar day required to complete the project means almost $3,000 in interest alone. For this reason, design and construction have been combined in one section of this paper because they are carried on just that intimately. The instrumentman on the survey is apt to see a bulldozer when he takes a backsight.

Successful performance on a revenue bond project in connection with a major highway requires a large and closely coordinated engineering organization capable of producing contract drawings and specifications and seeing the work through to completion with the least possible loss of time and effort. For this reason consulting engineers are invariably employed to carry out assignments for toll road authorities.

On the $220 million New Jersey Turnpike, seven separate consulting engineering firms were employed in addition to the Turnpike's own engineering staff. The combined staff of these organizations numbered more than 1,500, from which personnel were selected a staff for the Turnpike assignment with the specialized talents needed for this important project.

The bonds for such ventures are usually sold before contract plans and specifications are prepared, the appropriations from state legislators usually being sufficient only for preliminary engineering. Interest charges are going on, therefore, all during the time the design work is being done. For this reason, work that would be spaced out over much longer periods on a project paid for by public funds is done simultaneously on a number of sections and by a large crew on a toll road project.

Modern earth moving equipment has changed the concept of what a reasonable depth of cut or height of fill is on work of this nature. On the New Jersey Turnpike a single contractor in one 24-mile section had an estimated half million dollars worth of earth moving equipment on the job at one time. Through this highly mechanized operation, the contractor is able to move earth for as little as $0.33 per cubic yard for a base haul of 6000 feet.

On the DeLeuw Cather section of the New Jersey job there are many cuts 20 to 30 feet in depth and a maximum fill, that approaching the Raritan River, 78 feet in height. Fills are built up in 6-inch layers, every layer consolidated as placed from 90 to 95 per cent compaction, modified AASHO.

Concession areas are carefully planned on modern turnpikes so as not to present traffic hazards nor detract from the scenic beauty of the highway.

(*Continued on Page* 28)

WSE Plans 2nd Engineers' Forum

Schedules Meetings for Next Autumn

WSE's first Forum for young engineers has proved an outstanding success both among the 102 young engineers participating and industry in general. Therefore, the Western Society of Engineers has decided to sponsor a second Young Engineers' Forum next fall.

Western Society has received many appreciative letters and comments, both from the young engineers attending the present Forum and from interested members and non-members who have heard about the program. Phil S. Hanna, feature writer of the *Chicago Daily News*, commended WSE's new method of practical education for young engineers.

The fall Forum is tentatively scheduled to start in October, and to continue in the same format of the initial Forum, with a series of dinner meetings held approximately every two weeks. Again the Forum will limit its enrollment to 100 young engineers, keeping the meetings small and flexible enough to be of top value to the group. However, it is expected that the second Forum will limit the number of nominees from each company to three, thereby giving the young men a greater opportunity to meet engineers outside their own fields. Engineers enrolled in the current Forum represent 25 different companies in the Chicago area.

Subjects now under consideration for the fall Forum meetings include the six offered at the first Forum, (utility, general manufacturing, railroads, oil, steel and construction), plus banking and finance, the chemical industry, and meat packing and raw materials. Of this list, six subjects, best suited to the second Forum nominees, will be selected.

This training program, designed to acquaint the young engineer with the major lines of business in the Chicago metropolitan area and the part these businesses play in the community, is evidence of WSE leadership in providing practical education for young engineers.

Mr. William V. Kahler, president of Illinois Bell Telephone Company clearly summed up the objective of the Forum when he said at the first Forum meeting, "An engineer, in order to be of maximum value to society, must be a well-rounded individual who is capable of understanding and evaluating a great deal more than his own job in our complex industrial system and certainly more than the strictly technical engineering aspects of the problems he's dealing with at the time. He must be engineer, businessman, financial expert, public relations counsellor and citizen, all rolled into one."

Other Chicago area industrial leaders taking part in the first Forum are: James J. Nance, president of Hotpoint, Inc.; John W. Barriger, president, Monon System; J. Porter Langfitt, senior vice-president, Pure Oil Company; F. M. Gillies, executive vice-president, Acme Steel Company; and Bruce A. Gordon, owner, Bruce A. Gordon Company.

Many young engineers who could not be accommodated in the first Forum have already expressed a desire to enroll in the fall series.

Crerar Library

News and Notes

Why do technical men not use libraries more than they do? Librarians often ask themselves this question. Many technical men use the library intensively, but many more use it very little and some do not use it at all. Mr. George F. Hand, Materials engineer in the Research and Development Department, Pullman-Standard Car Manufacturing Company, has attempted to answer the question for his company librarian. We are indebted to him for permission to paraphrase his explanation.

Part of the answer lies in the feeling by technical men that the library is "sissy" and "bookish." The use of the word "literature" carries with it, unfortunately, the connotation of "literary." The library is not thought of as a place for practical men to do part of their work.

For some, the answer is that the boss frowns upon it. One boss said to a librarian when he heard one of his employees had been consulting a library, "He'll have so much to do soon that he won't have time to spend in the library." In another instance, an employee expressed appreciation for information received from the library but did not wish his boss to know of it because he was presumed to know his job when was hired. To use the library was an admission that he did not know everything about his job.

Another explanation is that the technical man does not feel at home in the library. His professional education has

(*Continued on Page* 29)

WSE '51 Regular Ticket Elected

Becker, Eshbach, DeLeuw and Sullivan Chosen as Officers

Officers of Western Society of Engineers for the year 1951-52 have been announced by the Board of Direction following the annual election.

The report of the judges of election to the Board on April 26, 1951, shows that the regular ticket, nominated under the constitution, was elected unanimously.

Donald N. Becker was elected president for the coming year. Ovid W. Eshbach was elected first vice-president and Charles E. De Leuw, second vice-president. John F. Sullivan, Jr. was reelected treasurer.

New trustees, to serve for three-year terms are Albert P. Boysen and William R. Marston. Trustees continuing to serve are Leroy F. Bernhard, and Ludwig Skog, one year; and L. E. Grinter and A. W. Howson, two years.

James D. Cunningham and Albert Reichmann will serve as members of the Washington Award Commission for three years.

Donald N. Becker

Donald N. Becker has been chief structural engineer with A. J. Boynton and Company since March, 1948, and previously was engineer of bridge design for the City of Chicago for 24 years. He was graduated from Rensselaer Institute in 1908 with the C. E. degree.

Mr. Becker joined WSE as a member in 1920 and has served as a director of the Bridge and Structural Engineering Section for six years, including one year as chairman. He has been chairman of the attendance, admissions and finance committees, and has served on the library, fellowship and civic committees, and as sponsor of the junior division.

He was a trustee of the Society from 1944 to 1946. In November, 1948, he was elected to fill the unexpired term of treasurer, and was reelected treasurer in May, 1949, Mr. Becker served during the past year as first vice-president of WSE.

Ovid W. Eshbach

Ovid W. Eshbach has been dean of Northwestern University's Technological Institute since 1939. After receiving his Bachelor's and Master's degrees from Lehigh University, he served as engineer and personnel advisor for Pennsylvania Bell Telephone and A. T. & T. in New York.

He dealt with the technical employment of young engineering graduates for the Bell laboratories, taught at Brooklyn Polytechnic Institute, and supervised the graduate electrical engineers group from MIT who were working part-time at A. T. & T. as part of their course.

Dean Eshbach served as second vice-president of WSE in 1950-51. He is a fellow of the American Institute of Electrical Engineers. He was the recipient of the Octave Chanute medal in 1945, and has been active in WSE affairs since he joined in 1941.

Charles E. DeLeuw

Charles E. De Leuw, president of De Leuw, Cather, firm of consulting engineers on transportation, railroads, highways and other industrial engineering, was graduated from the University of Illinois with a B.S. degree in civil engineering.

Mr. De Leuw was employed as chief engineer of the Department of Subways and Superhighways, City of Chicago, from 1942-44. His engineering assignments have included transit studies for Chicago, Detroit, Los Angeles, Baltimore, St. Louis, Cleveland, Cincinnati, Washington, Montreal and Toronto.

Charles De Leuw, a member of WSE since 1913, has served on the hydraulic, sanitary and municipal, and traffic engineering and city planning sections; the consulting engineering division; membership committee and awards committee. He has been chairman of the H. S. & M. and traffic sections and chairman of the consulting engineering division.

Mr. De Leuw served as a trustee on the Board of Direction of the Western Society of Engineers from 1947 to 1950.

John F. Sullivan, Jr.

John F. Sullivan is the assistant to the vice-president, in charge of service and construction, Commonwealth Edison Company. After receiving his engineering degree from the University of Wisconsin, Mr. Sullivan went to work with General Electric Co., and later joined the Commonwealth Edison Company in 1925. He started with Edison as a field engineer, becoming superintendent of the structural and mechanical division in 1936 and superintendent of construction in 1943. He has been assistant to the vice-president since 1946.

Mr. Sullivan joined the Western Society in 1928 and is a member of the mechanical engineering section. He is past president of the Illinois Engineering Council and a member of the American Society of Mechanical Engineers.

Albert P. Boysen

A. P. Boysen, division engineer, American Bridge Company, joined the Western Society of Engineers in 1931. Mr. Boysen has been associated with the American Bridge Company since he finished his studies at Armour Institute in 1915.

Albert Boysen has been active on WSE's admissions, membership and fellowship committees, and twice served as chairman of the program committee. He served as the 1950-51 chairman of the publications committee.

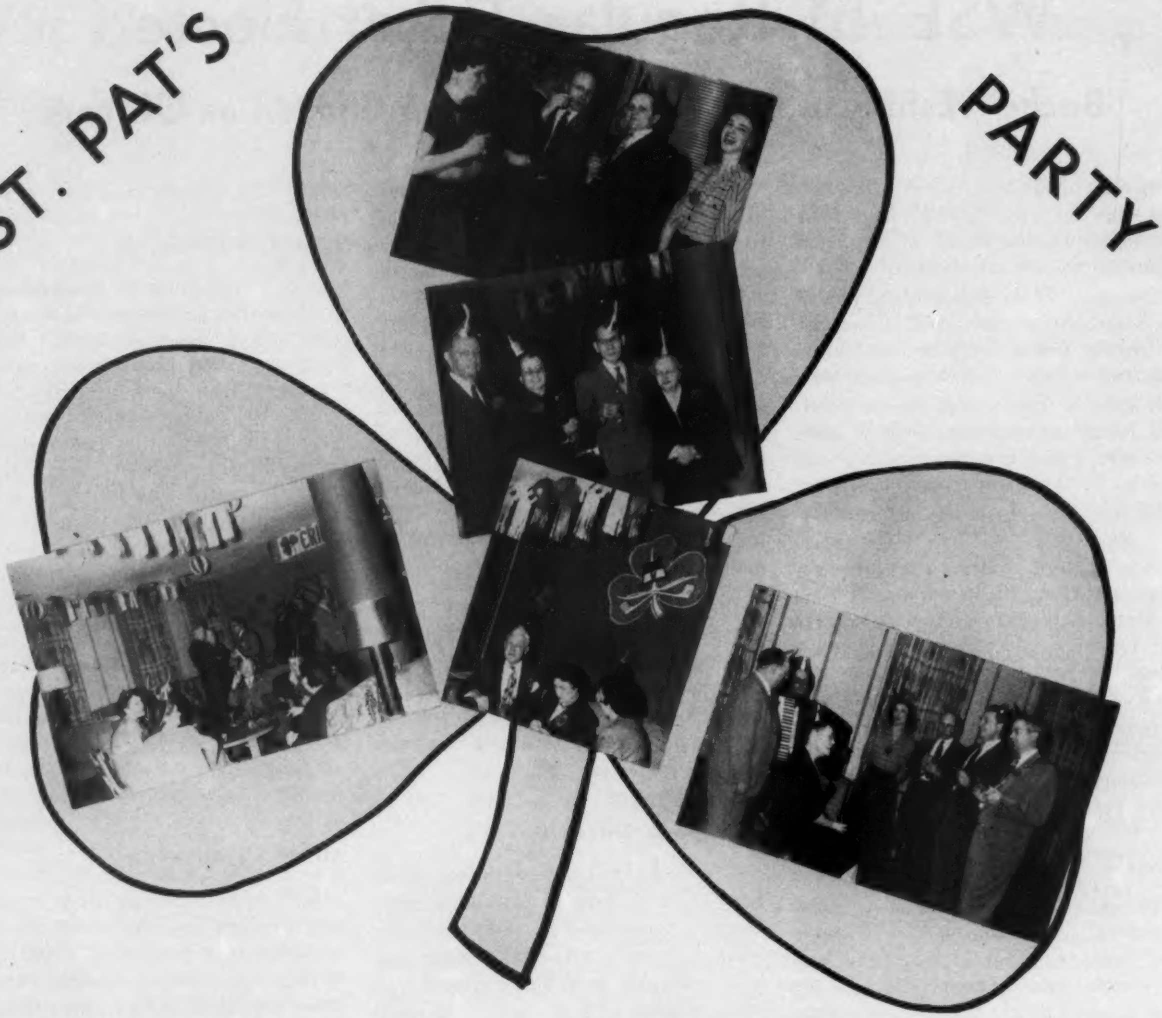
William R. Marston

W. R. Marston received a B.S. degree in railway electrical engineering from the University of Illinois in 1931, and upon graduation became associated with the Chicago Surface Lines as a student engineer.

During the last war, Marston worked as business analyst with the OPA on special research on tire rationing methods.

(Continued on Page 29)

ST. PAT'S PARTY



Center,

Top: Laughs were long and hearty when these WSE partyers got together: Mrs. Schlax, Clif Hubbell, Bill Schlax and Mrs. Hubbell.

Middle: WSE's new president, Don Becker, and Mr. (a new WSEer) and Mrs. Dick Mine take time out to pose for the cameraman.

Bottom: Mr. and Mrs. Egan and unidentified colleen should have lots of luck with all the shamrock spread around.

Left: View of the doings, decorations and the somewhat obscured sentiment of Erin Go Brau!

Right: Tut Tuttle, Dot Merrill, the Hubbells, Ken Reed and Larry Langdon blend their voices in close disharmony.

Shades of Mrs. Murphy's chowder, if that legendary engineer, St. Pat, didn't show WSEers a gay Irish time at the Society's second social evening of the year, March 19th.

Everyone remembers that WSE went back to the farm for its first party night last fall. The second social eve was somewhat rural too, only this time WSE traveled across the sea to Ireland.

Engineers exchanged their slide rules for shillalahs and gay green shamrocks subbed for blue-prints. And just for that night they answered to the names of O'Brien and MacGonicle, O'Rourke and Harrigan.

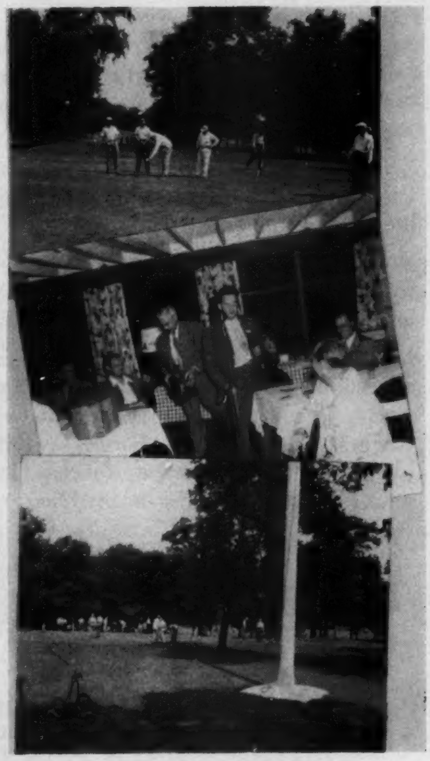
These sons of old Erin and their fair colleens puffed on their pipes (corn cobs instead of clay), and crooned the lilting Irish ballads, accompanied by that fine old Irish instrument, the accordion. And the leprechauns, those little folk of Erin who bring good luck, hid under the rugs and the chairs, watching the party and enjoying the fun.

And what would they serve at an Irish feast but corned beef and cabbage, that national food of the country. The heaping plates and seconds too filled even the hungriest Pat or Mike.

The only way Pat's Party fell short of old Irish tradition was—Clancy didn't lower his boom!

For a better than par day . . .

join WSE on the fairway



Views of last year's tourney

SECOND ANNUAL

GOLF TOURNAMENT

NORDIC HILLS COUNTRY CLUB
Itasca, Illinois

FRIDAY, JULY 20, 1951

ALL DAY OUTING
TEE-OFF TIME — 9 A.M.
GOLF REGISTRATION LIMITED TO 200
PRIZE AWARDS AT DINNER — 6 P.M.

Reserve

Your Place

NOW

NAME: ____________________

ADDRESS: ____________________

NO. OF RESERVATIONS: _____ TELEPHONE: __________

Golf and Dinner	$6.00	_____
Golf Only	2.75	_____
Dinner Only	3.50	_____

AMOUNT ENCLOSED: __________

(Checks payable to the Western Society of Engineers, 84 E. Randolph, Chicago 1.)

Starting time reservation _______ a.m.

(Subject to committee approval)

PLAY GOLF

WITH WSE!

WSE's Engineers' Forum . . .

Now that WSE's Young Engineers' Forum ha received plaudits both from participants and ind method of practical education, the plan can be ex it works.

First and most important came the idea and t wick's. His sincere interest in the welfare of the rest of the job easy.

Next industry was contacted to enlist the aid five companies in the Chicago area agreed to spo engineers.

Top industrial leaders were lined up as spe shared their background and knowledge with the yo many details to get the Forum in top running orde General Chairman, Dr. Gustav Egloff; William Ma all the section chairmen worked hard and long in young engineers with a wider business horizon.

One WSE member acts as host for each ta neers, they switch tables at every meeting. Public Service; D. W. Gilman, Edison; T. nings, DeLeuw, Cather; J. T. Ahern, St Sargent & Lundy; Douglas Muster, I.T., a

Left: Forum speakers are top to bottom—W. V. Kahler, pres., I.B.T.; J. Nance, pres., Hotpoint; J. Barriger, pres., Monon R.R.; J. P. Langfitt, senior v.p., Pure Oil; Bruce Gordon, owner, Bruce A. Gordon Co.; F. M. Gillies, exec. v.p., Acme Steel, is not pictured, all men quick with the engineering answers.

n...and how it works

s' Forum has proved its merit and nts and industry as being a novel n can be examined to see just how

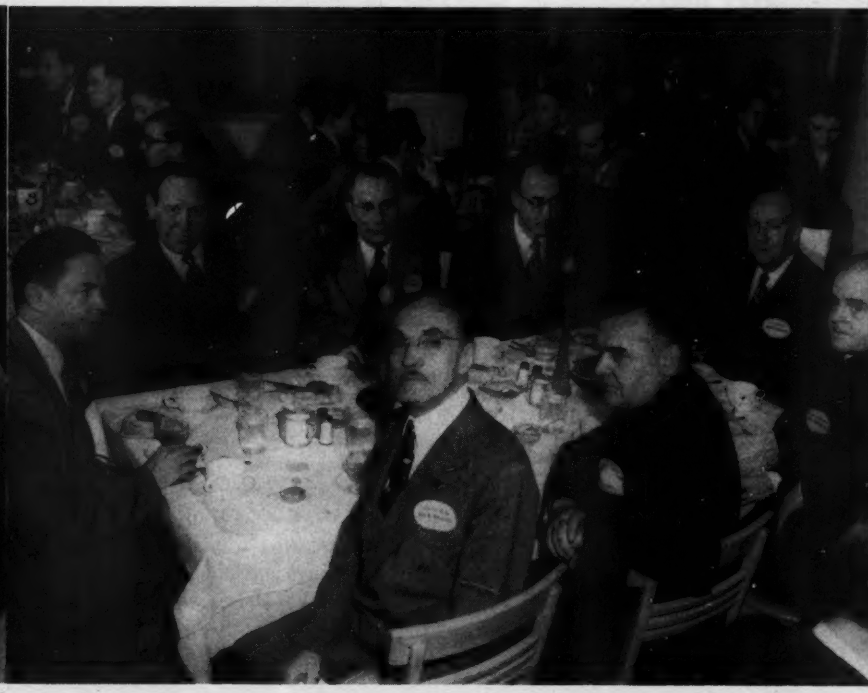
e idea and that was Mr. H. P. Sed- welfare of young engineers made

list their aid in the Forum. Twenty- greed to sponsor 102 bright young

d up as speakers. They willingly e with the young men. Finally, the running order were necessary. The William Marston; Tom Ayers; and and ing in this plan to acquaint horiz

Above: WSE president, H. P. Sedwick, views Forum proceedings. Mr. Sedwick initiated the Forum plan. Below: At speakers' table, starting at 9:00 o'clock: T. Ayers, Public Service; J. Nance, Hotpoint; W. Reace, Edison; M. Joslin, Public Service; D. Becker, A. J. Boynton; J. Marshall, Procter & Gamble; P. Monaghan, Hotpoint; G. Egloff, Universal Oil Products.

ost for each table. To meet more young engi- every meeting. Seated below are: J. O'Reilly, n, Edison; T. F. McKeown, Edison; Emil Hen- T. Ahern, Stone & Webster; P. R. Cassidy, Muster I.T., and Titus LeClair (WSE), Edison.



memos on WSE members

Summer's just a calendar page away. Soon WSE members and WSE's magazine will be enjoying their vacations. But we expect to see you out at the second annual Golf Tournament, July 20, at Nordic Hills C.C., And what's more, we expect to hear from you. Drop us a postcard from the lake or the mountains or even from the drafting board.

You'll be receiving your 1951-52 invoice shortly, and when you return it with your dues, please answer the questions completely to bring our records up-to-date.

Although the May magazine is something big in *Midwest Engineer* history (a full 36 pages), a most important memo has grown rather old in our misfile. As of the first of this year, **Fred A. Hess,** a WSE member since 1922, was named assistant to the vice-president of the New York Central System. Fred Hess had previously been division engineer for the New York Central's terminal lines in the Chicago area.

Fred Hess

He has spent his entire railroad career in and around Chicago. After graduating from Armour Institute of Technology with a degree in civil engineering, he started work as a junior engineer in the U. S. Yards in Chicago. Fred was employed as a draftsman, and chief draftsman and finally assistant engineer in the vice-president's office of the Yards. In 1944 he became assistant to the general manager of the Indiana Harbor Belt and Chicago River & Indiana and shortly thereafter, division engineer.

F. G. Frederick, another WSEer, succeeds Mr. Hess as the N.Y.C.'s division engineer. Mr. Frederick had been the System's assistant division engineer in this area.

A. J. Boynton Company has had several changes in WSE personnel lately. **Carl Kreutziger,** Boynton's contract manager, has gone southwest to those wide open spaces of Texas to become chief engineer, Lone Star Steel Company, Dallas.

A new name on the Boynton roster is that of **D. G. Wheeler, Jr.** who now designs bridges for that company. Mr. Wheeler was formerly a bridge design engineer for the City of Chicago.

G. Earl DeBourge is another Boynton newcomer. Mr. DeBourge, formerly a self-employed evaluation engineer, now does the same job at Boynton.

A new International Harvester, **George Lancaster,** writes he is now product research engineer, advanced engineering group, industrial power engineering department. Mr. Lancaster was associated with the Chicago Transit Authority until he joined IH two months ago. His new position will include investigations in the field of fuels and lubricants.

Roy A. Paulson is now general manager of A. C. Woods & Company, manufacturers of structural and welded steel products. Formerly a contracting engineer with Allied Structural Steel Company, Chicago, Mr. Paulson now lives in Rockford where A. C. Woods is located.

A DeLeuw, Cather engineer, **Arthur W. Keith,** has been transferred to that company's office in the land of wells with oil and Indians with Cadillacs, Oklahoma, Stroud to be exact.

Another transfer, this time in the opposite direction, is that of **W. J. Fairbairn.** Mr. Fairbairn, a special research engineer with Factory Insurance Association has left the Chicago office to continue his duties in Hartford Connecticut.

This month's final move is just a distance of several miles. **Wallace W. Elliott,** a supervisor for Commonwealth Edison, has transferred north to that company's main office. He used to get his mail at the S. Throop Street station.

Obituaries

On April 3 of this year, Charles Waldmann died in Passavant hospital. Director of development for the Chicago Housing Authority, Mr. Waldmann was a member of the board, chief engineer and president of Park Forest Water Company (American Community Builders, Inc.)

Mr. Waldmann had been principal engineer in the Federal Public Housing Authority; senior chief engineer, Resettlement Administration of the U.S.; and chief engineer and vice-president, Wal-Dorf Engineering Company in New York and New Jersey.

Mr. Waldmann joined the Western Society of Engineers as a member in 1949.

John P. Ball, a life member of the Western Society and a member since 1903, died on April 23.

Mr. Ball was Chicago park district assistant chief engineer at his retirement 12 years ago.

He was active in the Hydraulic, Sanitary and Municipal Section of the Society, and always a hardworking member.

Another WSE life member passed away recently. Julius Floto, Chicago architect and structural engineer for 50 years, died March 30. Mr. Floto designed and built many Chicago buildings which included the designing of the annex for the Art Institute, the engineering for the Natural History Museum and the first laboratory for testing the atom bomb at the University of Chicago.

Mr. Floto, who was a member of Western Society since 1905, was the founder of the Chicago Technical College.

Western Society just recently heard of the death of Chester L. Post, August 21, 1950.

Mr. Post was a consulting engineer for the Public Building Administration of the Federal Works Agency in Washington, D. C. He became a member of the Western Society of Engineers in 1919 and a life member in 1949.

Batter Up!

BY HENRY PENN, M.W.S.E.

Presented at a WSE Luncheon-Meeting

baseball follows a book of engineering principles

This country's enthusiasm for baseball, the great American sport, seems to be timeless. While it may be true that a player is old at 40, the fan is never too old to "root" and enjoy the game. The flashy speed of each individual player is one of baseball's greatest characteristics. And the physicist's and engineer's appreciation of the sport can be greatly increased if he will apply his technical knowledge to the problems involved in baseball.

A normal baseball game is a succession of constantly changing situations. At defense position, each player can predict most of the plays that can occur, and be reasonably ready to throw the ball when it comes his way. Statistics show there are 27 putouts and 18 assists in a normal game. Therefore, the average player can expect to make two important throws and three important catches during each game. These plays require precision, rapid execution and constant practice.

Pitcher's Job Strenuous

By contrast, the contest between the pitcher and the batter is a continual battle of wits and energies. Any pitch may be the critical one. During a game, the record shows that over 69 pitches are used. Add to this the 25 to 50 warm-up throws and the 40 between inning practice pitches on the rubber, and see that it totals about 160 pitches per game. This constitutes a tremendous expenditure of energy, and it's no wonder that pitchers can lose 7½ lbs. during a hot summer's game.

Many styles of pitching have developed. Right handers swing the arm anywhere from slightly below horizontal to the vertical. Southpaws, on the other hand, are not usually straight arm pitchers and seldom swing 45 degrees above horizontal.

To increase speed or to save energy, the side arm pitcher usually starts his motion by lifting one leg and swinging it toward the batter. This motion adds body velocity of the arm. To get the same result, the over-hand pitcher adds the vertical velocity of the body above the waist to the arm and ends up with the wrist flip. The "follow through" results from proper action and does not contribute to it.

Guy Bush, the colorful old Cub pitcher, used to fall on his knees in an effort to get body velocity. This freak position probably endangered his life. After the pitch is released nothing will change it, not even body english. The principles involved in pitching are easily explained by physics.

Batting Follows Engineering Principles

The swing of the bat will also recall the physics class. Attempting to move the bat along the track of the pitched ball is the major problem of the batter. The speed of the handle must about equal the speed of the bat end. The beginning and end of the stroke can be radial or any other type curve. Whether the batter gets a bunt or a home run is entirely dependent upon the speed of the stroke that drives the ball.

Another factor that determines whether the stroke will be a good hard hit or just an infield popout is the "sweet spot." If the ball does not contact the "sweet spot" of the bat, part of the force is absorbed by the hands stinging them on a cold day.

These are the basic points on pitching and batting. The following tabulation may help explain how baseball is built on engineering and physics principles:

1. The story that a ball cannot be curved is obviously incorrect since the fall of even a straight ball cannot easily be overcome because of gravity. For example, if a ball travels 60 feet in .5 second, the fall will be equal to $\frac{1}{2}gt^2 = \frac{1}{2}x32.16x.5^2 = 4$ feet, it is therefore practically an impossibility to throw a straight ball.

2. In most cases the ball, by being rolled off the fingers before release, has a combination of motion of rotation and translation. A cone-shaped body of compressed air streamlines the ball's forward travel. Rotating the ball pushes the compressed air out of line and a component of unbalanced air pressure tends to swerve it to one side or another in the direction of rotation on the forward side of the ball. A side arm delivery produces an incurve by rolling the ball horizontally along the fingers. An overhand pitcher gets a hop upward which partially overcomes gravity. Although it does not overcome the 4 foot calculated drop, to the eye of the batter it appears to rise.

The curve and drop are produced by twisting the ball downward by an overhand or partially overhand pitcher. Many variations, such as the screw ball, have been developed from this pitch. Right-handed pitchers produce

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Batter Up!

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the screw ball by sliding the fingers to the left of the ball, causing it to curve toward the right-handed batter. Lefties and right-handers simply reverse the curves and produce opposite effects on batters on the same side of the plate.

Slow balls, or the technique of changing pace, is used to confuse the batter's timing. "Dizzy" Dean used a fast ball, a slow ball and then a still slower one, thrown with identical motion. A favorite slow throw is the knuckle ball. It is pushed forward and appears to approach the batter without rotating its seams. This ball has only motion of translation. Its effectiveness, like all slow balls, is in the unexpectedly long time it takes to reach the batter.

Explain Batting Problems

Batting problems are also plentiful, and also have a scientific explanation:

1. As the batter hunches in the box, the ball bears down on him at roughly 82 miles an hour, a speed that would make the most steely-nerved player wince.

2. The eye must change focus to hold the perfect image of the approaching pellet.

3. The man on the mound has a lot of leeway in his pitches, what with the curves, deceptive motions and varying speeds.

4. Timing has proved that .2 of a second is necessary to react to any influence. The curving or directional change of a pitched ball takes effect usually in the last one-third of its travel. With the total travel time only .5 of a second, it is apparent that the batter's reaction to change requires both anticipatory motion and accurate coordination.

5. Also, the bat is round and no more than 2½ inches in diameter. The ball is spherical and only 9 inches in circumference. To hit a sharp single, the batter must connect slightly below the baseball's middle. Hitting the ball too high results in a grounder, and whacking it too low spells "fly ball."

6. Bunting is hitting with the intention of causing a slow roller. This is executed by drawing the bat back to absorb some of the energy in the ball.

From the offensive position, very little engineering is involved in base running. However, defensively, to catch a man off base, a pitcher tries to time his throw to catch the runner in motion. Physics again—a body in a state of motion tends to continue in that state until some force intercedes. In this case, the runner must dig in his cleats, halt his run, and hurry back to base.

Workings of a Batter

Picture a 300 plus hitter at the plate. Three out of every ten times he has made a hit, and he wants to keep his average up. The first pitch is a strike, and the batter tightens up. He starts his anticipatory swing, only to see the leather orb streaking for his chin at 82 miles an hour. He ducks for the ground, nerves atingle. Now the count is three balls, two strikes. This is the big pitch. The batter's ready, ready for a fast ball. Again that preliminary swing, with the bat in fast motion. He discovers the ball approaching just half as fast as expected. The batter misses time. The ball plucks into the catcher's mitt. He strikes out!!

In the face of the tremendous mental turmoil and strain a batter experiences at the plate, is it any wonder Casey struck out?

OIL,

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is estimated that one strictly "wildcat" well has been drilled for every 12 square miles of favorable oil area, while outside the United States only one such well has been drilled for every 480 square miles.

In 1900, there were about 80,000 producing wells in the United States. From 1900 to 1950, around 740,000 producing wells were completed, making a total of 820,000 wells. However, during the fifty years, 370,000 of these producing wells were either abandoned as unprofitable or shut down because of proration, or other reasons, so that there are now about 450,000 producing wells. In fifty years, the maximum depth of producing wells has increased from less than 3,000 feet to more than 15,000 feet. One well has been drilled to a record depth of 20,521 feet in Wyoming. Although the drilling of this well cost a million dollars, it was abandoned as a dry hole. On March 2, 1951, a Mississippi wildcat well at 20,300 feet blew out natural gas and gave indications that it might be a producer of condensate or oil. Drilling for oil continues at a rapid rate in the United States. In 1950, a total of 43,204 wells representing a total footage of 159,288,000 feet were drilled, or 30,000 miles. Of these wells, 35,424 were so-called "field wells" drilled to develop and extend proven areas while 7,780 were strictly "wildcat" drilled in the completely new and untested territory. The figure given on field wells includes not only those drilled with the object of finding oil or gas, but also those drilled for water flooding, gas injection and salt water disposal. It should be noted that only 1,009 of the 7,780 wildcat wells produced oil or gas in commercial quantities while 27,251 out of the 35,424 field wells yielded significant production of oil, distillate or gas.

Petroleum and Natural Gas Reserves

In considering reserves of petroleum and other hydrocarbon fuels such as natural gas and natural gasoline, it is imperative that a sharp distinction be made between proved and ultimate reserves. Proved reserves are those known to be present in producing oil fields, and recoverable by current production methods. The proved reserves calculated by geologists are purposely conservative and experience has shown that ultimate production may be many times the volume of proved reserves.

Ultimate reserves are of a highly speculative character, and are based on a consideration of the number and extent of geological formations in which oil is likely to be found. In the United States it is expected that ultimate reserves will be three times the present known volume of proved reserves. However, the factor in some localities may be ten to one.

U. S. Proved Reserves of Petroleum

The ratio of U. S. proved reserves of petroleum to annual production has been recorded in detail since 1900, and in the face of steadily increasing yearly output has been and is still being maintained at a safe level. Table VI shows annual production, proved reserves at the end of the year and the ratio of proved reserves to production for 1900 to 1950 by ten year intervals. The first line shows that only 940 million barrels of petroleum were produced between 1859 and 1899 and that of the reserves found in this time interval, 2.5 billion barrels remained at the end of 1899. In 1900, with a production of about 63 million barrels, there were 45.6 years supply of oil in sight assuming a continuance of the 1900 annual production rate. The number of years' supply reached a minimum of 10.4 in 1923, but since that time has been maintained approximately constant at fourteen years. Beginning with 1946, estimates of proved reserves of natural gas liquids have been made and reported separately from petroleum. In Table VI, the figures given for 1950, include both natural gas liquids and petroleum.

For the past fourteen years, the increased proved reserves in the United States have been based more on enlargement of producing fields than on new fields. Table VII shows the ratio of reserves added by extension of producing areas to those added by new discoveries from 1937 through 1950. From 1937 through 1946, the figures refer only to crude oil. From 1947 through 1950, they include natural gas liquids.

U. S. Controlled Foreign Oil

A large percentage of foreign production and reserves are at present under U. S. control. In the last twenty years, American companies have added over 20 billion barrels of foreign oil to our available reserves. On January 21, 1928, total proved foreign reserves were 12,597,189,000 barrels of which American companies controlled 2,080,216,000 barrels or 16.51 per cent. On January 1, 1949, proved foreign reserves were 50,222,000,000 barrels of which American companies controlled 22,060,680,000 barrels or 43.8 per cent. Thus in twenty-one years the foreign oil reserves controlled by the United States increased about ten fold. On January 1, 1949, U. S. proved reserves were 26,821,000,000 barrels and our foreign reserves were therefore 83 per cent as much as our domestic supplies. Of the total world's proved resources, the United States now controls about 60 per cent.

In 1949, United States interests controlled about 75 per cent of the more than 10 billion barrels of proved reserves

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in South America, more than 40 per cent of the 33 billion barrels of proved reserves in the Middle East and nearly 30 per cent of 1.3 billion barrels of proved reserves in the Far East, not including Asiatic portions of the Soviet Union.

U. S. Natural Gas Reserves

The United States is more than maintaining its reserves of natural gas as well as its reserves of petroleum and natural gas liquids. From the beginning of the natural gas industry to the present time, it has been estimated by the Geological Survey that about 100 trillion cubic feet of natural gas have been produced in the United States. In 1950, U. S. production of natural gas was 6.892 trillion cubic feet. In spite of the production of this tremendous volume of gas, proved reserves increased from 180 trillion to 185 trillion in the same year. One estimate of our ultimate gas reserves indicates 500 trillion cubic feet, but even this may be low because less is known about gas than petroleum reserves.

Estimation of the world's proven oil reserves is more difficult than the estimation of our own because of lack of much essential information. For this reason, world reserve estimates are considerably less significant than those for the United States and are subject to extensive revisions. Geologists are in wide disagreement about the world's proved reserves.

TABLE VII

U. S. NEW RESERVES ADDED ANNUALLY
(Thousands of barrels)

Year	Added by extensions of proved fields	Added by new fields	Ratio of Extensions to New discoveries
1937	2,792,790	928,742	3.00
1938	2,243,571	810,493	2.76
1939	2,058,455	340,667	6.04
1940	1,607,012	286,338	5.61
1941	1,538,989	429,974	3.57
1942	1,618,925	260,051	6.22
1943	1,202,368	282,418	4.25
1944	1,556,192	511,308	3.04
1945	1,690,315	419,984	4.02
1946	2,413,628	244,434	9.81
1947	2,211,377	504,731	4.38
1948	3,804,600	461,164	8.24
1949	2,591,639	982,982	2.64
1950	1,997,769	546,916	3.64

Table VIII gives a recently published detailed estimate of world proved reserves by countries.

The total of about 95 billion barrels compares with an estimate of about 76.5 billion barrels made a year previously. A considerable proportion of the increase is due to the increased proved reserves in various fields in the Middle East. A recent estimate of global oil reserves made by a large U. S. oil company gave 117.3 billion barrels as proved reserves.

Both U. S. and world proved reserves have been steadily increasing during the years. From 1859 through 1950, the fields under U. S. land areas have yielded a cumulative production near 41 billion barrels and proved reserves of petroleum and natural gas liquids are nevertheless over 30 billion. The world's cumulative production to date is 65.5 billion barrels, and its proved reserves are in the order of 100 billion. Both U. S. and world proved reserves have increased annually despite increasing annual production. These facts would place any real shortage far in the future.

The volumes of oil thus far produced are trivial in comparison with the volumes of the earth's crust from which they have been obtained. The oil thus far produced in the U. S. would not fill a hole in the ground 1.5 cubic miles in volume, and the oil produced throughout the world would fill about 2 cubic

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TABLE VIII

ESTIMATED WORLD PROVED CRUDE OIL RESERVES, by Countries[1]

(Thousands of barrels)

	Estimated Reserves Jan. 1, 1951	% of World
NORTH AMERICA	28,722,224	30.17
Alaska	500	——
Canada	1,200,000	1.26
Cuba	4,000	——
Mexico	1,300,000	1.37
United States	26,217,724[2]	27.54
SOUTH AMERICA	10,650,000	11.19
Argentina	270,000	0.28
Bolivia	23,000	0.02
Brazil	26,000	0.03
Chile	30,000	0.04
Colombia	375,000	0.39
Ecuador	26,000	0.03
Peru	150,000	0.16
Trinidad	250,000	0.26
Venezuela	9,500,000	9.98
EUROPE	6,206,700	6.52
Albania	20,000	0.02
Austria	60,000	0.06
Czechoslovakia	2,500	——
England	3,400	——
France	14,400	0.02
Germany, West	160,000	0.17
Hungary	35,000	0.04
Italy	2,200	——
Netherlands	53,000	0.06
Poland	12,000	0.01
Roumania	340,000	0.36
U.S.S.R. (Russia)	5,500,000	5.78
Yugoslavia	4,200	——
AFRICA	183,200	0.19
Algeria	1,000	——
Egypt	180,000	0.19
Morocco	2,200	——
ASIA, TOTAL	49,445,500	51.93
ASIA, MIDDLE EAST	48,010,000	50.42
Bahrein	300,000	0.32
Iran (Persia)	13,000,000	13.65
Iraq	8,700,000	9.14
Kuwait	15,000,000	15.75
Qatar	1,000,000	1.05
Saudi Arabia	10,000,000	10.50
Turkey	10,000	0.01
ASIA, FAR EAST	1,435,500	1.51
Borneo, British (Sarawak and Brunei)	250,000	0.26
Burma	48,000	0.05
China	10,000	0.01
India	15,000	0.02
Formosa	500	——
Japan	22,000	0.03
Netherlands' Indies	1,000,000	1.05
Pakistan	20,000	0.02
Sakhalin	70,000	0.07
AUSTRALIA — NEW ZEALAND	500	0.00
TOTAL, WORLD	95,208,124	100.00

[1]World Oil, Vol. 132, No. 3, p. 234, Feb. 15, 1951

[2]U. S. crude oil only; not including 3,925,063,000 barrels of natural gas liquids estimated by World Oil. American Petroleum Institute release of March 8, 1951 gives as U. S. reserves 25,268,398,000 bbls. of crude petroleum and 4,267,663,000 bbls. of natural gas liquids.

miles. In the United States, 41 billion barrels or about 1.5 cubic miles has been produced from 2-½ to 3 million cubic miles of sedimentary formations, the volume of oil being a rather insignificant percentage of the total. No estimates of the total world's sedimentary rock volumes are available, but on an area basis they are probably about ten times the volume of similar rocks in the United States.

Ultimate Reserves

The question today is how much oil we may expect to produce before total reserves are finally depleted. On this point, the opinions of geologists differ widely. They have plotted the world's sedimentary formations in which it is reasonable to expect that petroleum will be found, and made estimates of probable future oil discoveries both on a surface area and on a volumetric basis. The highest prediction thus far made by a competent geologist indicates that there are still 1500 billion barrels of undiscovered petroleum reserves in the whole world, one-third of which is under land areas and two-thirds under continental shelves. This same estimate indicates that about 150 billion barrels of oil will be found in the Western hemisphere, and the remaining 90 per cent in the Eastern hemisphere. It indicates that the world has oil for the next four hundred years at the present annual consumption rate, which is now around 3.8 billion barrels a year.

An estimate of the world's ultimate oil reserves under land areas is given in Table IX. These figures, which do not include oil under continental shelves, indicate that about one-third of the estimated resources will be found in Western hemisphere countries and two-thirds in the Eastern hemisphere.

As to the future reserves of the United States, still another geologist has given the data in Table X which shows a break-up of sources. The total figure of 113 billion barrels is in fair agreement with that given in Table IX.

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It seems probable that new reserves in the United States will be found at generally greater depths. The most optimistic estimates thus far made and shown in Table X indicate that the United States has about fifty-five years of oil supply at present consumption rates. In evaluating such estimates, it should be kept in mind that thus far all estimates of ultimate oil reserves have been far too low and have been continually revised upwards. A large element of speculation enters into the prediction of these ultimate reserves, as in all prophecies.

The ultimate yield of petroleum from Russia and its satellites may be as high as 168 billion barrels compared with 100 billion for the United States, both based on sedimentary rock areas. The Russian reserves include those from the more promising oil regions of European Russia, Siberia, and Sakhalin Island. Russian petroleum resources are well located to supply the Moscow and Ural industrial areas, but long transportation lines are necessary for supplying the Ukraine, the Baltic states, Leningrad and West Russia. The Russian potential is much higher than that of continental United States. Up to 1950, less than 6.5 billion barrels had been produced in Russia where 41 billion had been produced in the United States.

TABLE IX

ULTIMATE WORLD OIL RESERVES UNDER LAND AREAS

Country or Region	Estimated Ultimate Reserves Billion bbls.	Percent
United States	100	16.7
Venezuela-Colombia-Mexico	45	7.5
Other western hemisphere countries	65	10.8
WESTERN HEMISPHERE (total)	210	35.0
Russia-Siberia	150	25.0
Middle East	150	25.0
Oceania (East Indian Archipelago)	35	5.8
Other eastern hemisphere countries	55	9.2
EASTERN HEMISPHERE (total)	390	65.0
WORLD (total)	600	100.0

Continental Shelves

The oil under the continental shelves of the world is believed to constitute a major portion of its reserves. About 11 million square miles of the world's continental shelves have been estimated to contain approximately 1000 billion barrels of oil. About 1 million square miles are off the coast of the United States including Alaska. This would indicate that there would be approximately 100 billion barrels of oil to be found under United States' continental shelves. This is the highest estimate made by any geologist, and is considerably at variance with the 20 billion barrels estimated in Table X.

The principal development in offshore drilling is taking place in the Gulf of Mexico, off the shores of Louisiana and Texas where exploration and production are undergoing rapid development. Producing wells have been brought in 20 miles from shore, in more than

TABLE X

U. S. ULTIMATE PETROLEUM PRODUCTION

	Billions of bbls.
From present wells	28
From undeveloped reserves	10
From new discoveries under land	35
From new discoveries under continental shelves	20
From secondary recovery	20
Total	113

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30 feet of water. At present, these wells are drilled from pile-supported platforms, some of which have cost over a million dollars. The formations from which oil is obtained are extensions of those found in low lands bordering the Gulf in Louisiana and Texas. Eleven fields have been discovered under these continental shelves and in 1950 they were producing 16,500 barrels a day. In addition, 18 gas or gas-condensate fields have been discovered but have been shut in because no means are available for transporting the gas production to the main land.

Underwater drilling is also practiced in Lake Maracaibo in Venezuela and wells have been drilled offshore from the Commodora Rivadavia fields in the Argentine. A well has been completed offshore from Mexico which is reported to be producing 36° A.P.I. gravity crude. The production potential is said to be 5,000 barrels a day.

Drilling and producing oil from under the continental shelves is expensive and future development of these reserves will depend upon the production of petroleum from land-based wells. The continental shelves will be a major source of petroleum and natural gas when their development is justified economically.

Conclusion

It should be evident from the foregoing study of our situation in regard to oil supplies that we are not going to run out of petroleum for a long time. It is probable that even the highest present estimates of oil reserves are too low.

The oil reserves of the United States are being maintained by continuous exploration and development of underground supplies even in the face of rapidly increasing demands. Advanced scientific methods are being employed in searching for oil, drilling wells and obtaining the highest yields from oil-bearing formations. Continental shelf development is only beginning, and geologists agree that the major portion of our ultimate oil supplies will be found under these areas. Not only are our experts continually finding more oil in the United States but they are also active in many foreign contries to supplement our domestic reserves.

The petroleum industry in the United States has a rich background of experience and is well organized technically and well capitalized financially. It is primarily interested in staying in business to supply petroleum products. Given the natural drive flowing from our incentive system, it will continue to furnish whatever oil we may need in the future.

Tollways

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They are equipped to provide all the necessary services expected by motorists, and to earn all of the revenue for the sponsors that reasonably can be expected. These concession areas must provide service stations where minor repairs can be obtained, as well as the usual services. Restaurant facilities must include lunch counters where truck drivers will feel welcome, snack bars for those in a hurry, and dining rooms for those with more leisure.

No motel, hotel, or trailer camp facilities have been provided in connection with any of the turnpikes built to date. We interviewed a number of the trucking companies operating in New Jersey at the time the facilities were being planned and found almost no interest in bunk houses for over-the-road truck drivers. The Pennsylvania Turnpike Authority permits commercial users having charge accounts to leave the highway at any one of the interchanges for over-night stops with the privilege of returning in the morning to complete their trips on a single requisition and transit ticket. It is likely that as toll roads are extended, however, public demand will develop for over-night accommodations at several key locations. It may be possible within the next few years, for example, to drive from Portland, Maine to Toledo, Ohio, a distance of approximately 1200 miles without leaving the limits of toll road rights-of-way.

An effort is made in landscaping to restore the rights-of-way to as near a natural condition as safety permits. While all large trees are removed for some distance from the edge of the pavement, side slopes are seeded or sodded and native bushes are planted generously. Care is taken that all borrow pits and gravel pits are in location beyond the view of the highway user after completion of the project.

Operation

The services of the consulting engineers do not end when the road is built and opened to traffic. Under the terms of the usual bond indenture, the turnpike authority is required to retain a consulting engineer to make annual inspections, advise on maintenance procedures, review the operating budget and advise on operating techniques. In addition, the turnpike authority sometimes has its own engineering staff to carry out the recommendations of the consulting engineer and also to make independent studies on plans for incidental improvements.

The bond indenture also customarily requires that a traffic engineer shall be employed to make studies preliminary to any change in toll schedules. Such an engineering firm is also employed in the event that refinancing is proposed to effect a saving in interest charges.

In conclusion it may be stated that

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WSE '51 Regular Ticket Elected

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He later took charge of a newly-formed transportation unit of the Gasoline Rationing Branch. After duty as a lieutenant in command of an LCI (L) in the Navy, he returned to the Chicago Surface Lines as traffic engineer. Last year Mr. Marston was appointed deputy city traffic engineer.

W. R. Marston has served on the civic committee and attendance committee and was WSE's 1950-51 program chairman.

James D. Cunningham

James D. Cunningham, trustee of the Western Society of Engineers from 1935 to 1937, is founder and president of the Republic Flow Meters Co. Mr. Cunningham, who was the 1950-51 president of the American Society of Mechanical Engineers, has served on the Washington Awards commission previously. Awarded the CTSC Merit Award in 1950, Mr. Cunningham was elected president of the Illinois Manufacturers' Association the same year.

Albert Reichmann

Albert Reichmann, a member of WSE since 1897, was awarded WSE's highest honor in 1945, honorary membership in the Society.

After completing his engineering course in Germany, Mr. Reichmann, an Iowan, started as a draftsman with the Lassig Bridge & Iron Works. He went with the American Bridge Company in 1891 and rose from a draftsman and computer to vice-president, the position he held until he retired in 1938.

Mr. Reichmann served as treasurer of WSE in 1906-13 and president, 1913-1914.

Crerar Library

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not informed him about the practical values of the library and has not prepared him to make use of its resources. He leaves college believing in the fallacy that books contain only theory and that they have no practical contribution to make to his work. He is not informed of the fact that books today contain far more experimental and practical information than they do theoretical knowledge.

Other fallacies which keep him away from the library are the belief that keeping up with information in his own field is sufficient, that "practical" work is a quicker source of information than use of library sources, and that only patent attorneys and research men use libraries. Valid as these explanations may be to the technical man, none of them are acceptable to a librarian of a company library or a large technical library like Crerar. He knows, partly from his own observations, but mostly from statements made to him by technical men who use the library regularly, that the library is the reservoir of accumulated scientific and technical information of every field of science and engineering and that the technical men who stay away from the library cannot possibly keep as fully informed of progress, even in his own field, as the man who has *found* the library and makes use of it.

Tollways

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engineers have joined with legal experts and investment bankers to satisfy a public demand for a modern type of highway. It is estimated that at least 30,000 miles of such highways are needed in rural areas alone, but only two per cent of them have been built to date. If this team of engineer-lawyer-banker can add a capable legislator and an administrator in each of our 48 states, perhaps we can have the other 98 per cent within our lifetime.

WSE Holds Midwest Power Conference Luncheon

Speaker, Colonel John Slezak, Follows Forum Theme

WSE was well represented at the annual Midwest Power Conference held April 4, 5 and 6 at the Sherman Hotel in Chicago.

The conference was sponsored by the Illinois Institute of Technology in cooperation with nine other universities and nine technical societies.

Western Society sponsored the luncheon on April 7 in the Grand Ball Room of the Sherman. Mr. H. P. Sedwick, president of WSE, and vice-president, Public Service Company of Northern Illinois, was luncheon chairman. Col. John Slezak (WSE), president of Turner Brass Company, spoke on "The Engineering Mind in Business."

Other WSE members who participated in the conference were: James D. Cunningham, Henry T. Heald, John T. Rettaliata, W. A. Lewis, H. C. Schroeder, H. L. Hoeppner, and Edward Allen.

In his talk, Col. Slezak observed that more effective utilization of human resources deserves at least as much attention as the utilization of material resources have received during the past fifty years.

Pleading the cause of practical engineering education, Col. Slezak continued, "We spend time and money in our colleges training our youngsters in various professions, but we do little or nothing in preparing them to use this newly acquired knowledge effectively to their own and to society's best interest. We leave this almost entirely to chance. Would it not be wonderful if, for instance, every young engineer graduating from a school were trained not only to evaluate the assets he has acquired there in terms of their application to his potential jobs, but also in terms of their use in his being a more effective member of society and a better citizen of his country!!"

Col. Slezak said that much too often we are wastefully ineffective because we ignore the simple and obvious. He believes, "If our youngsters were drilled and disciplined to do at least a minimum amount of orderly thinking in the approach to their everyday life problems, we would be making great strides toward a more effective utilization of this greatest of all under-developed resources—the human capacity to create and to produce."

The full text of Col. Slezak's speech will appear in a later issue of the *Midwest Engineer*.

Science-Security Talks To Be Held Friday, May 18th

"Science and National Security" will be the title of the Conference to be sponsored by Roosevelt College, May 18.

A panel discussion by Prof. Mark Graubard, department of physics, University of Minnesota; state senator Noble W. Lee, dean, John Marshall Law School; and Prof. Morton Grodzins department of political science, University of Chicago, will probe the question, "What Is Loyalty for the Scientist?"

At the evening session Dr. James Arnold, Institute for Nuclear Studies, U. of C.; and Byron Miller, attorney for the American Jewish Congress and co-author, "The Control of Atomic Energy," will speak on "Do Security Regulations Hamper Scientific Research?"

Registration begins at 1 p.m. at Roosevelt College. The afternoon session gets underway at 2 p.m., with dinner in Altgeld Hall at 6:30 p.m. The evening meeting convenes at 8 p.m. Write Morris Goran, Roosevelt College, 430 S. Michigan, Chicago 5, or call WA2-3580 for additional information.

Joseph Decker Returns To Navy

Joseph R. Decker, who has been the manager of the Chicago office of the Engineering Societies Personnel Service since August, 1948, has been recalled to active duty in the Civil Engineering Corps (Seabees), United States Navy.

Mr. Decker will return, May 3, to his previous rank of Lt. Commander. He has been granted a leave-of-absence from the managership of the Chicago office of ESPS, and Mr. Bonnell Allen will be acting manager.

Joseph Decker was for many years engineer and sales representative for a large electrical products manufacturer.

Mr. Decker's predecessor, Mr. Thomas Wilson, retired from his job after 16 years in its service.

The Western Society of Engineers wishes Mr. Decker the best of luck and hopes his return to the fifth floor ESPS offices will be rapid.

WSE Applications

In accordance with the By-laws of the Western Society of Engineers, the following names of applicants are being submitted to the Admissions committee for examination as to their qualifications for admission to membership into the Society in the various grades, i.e., Student, Associate, Member, Affiliate, etc. All applicants must meet the highest standards of character and professionalism in order to qualify for admissions, and each member of the Society should be alert to his responsibility to assist the Admissions committee in establishing that these standards are met. Any member of the Society, therefore, who has information relative to the qualifications or fitness of any of the applicants listed below, should inform the Secretary's office, 84 E. Randolph St., RAndolph 6—1736.

158-82 Knight D. Farwell, Partner, Pace Associates, 53 W. Jackson Blvd.

159-82 John A. Alexander (Trsf.), Project Engineer, E. I. DuPont Co., Kennedy Ave., East Chicago, Ind.

Racine Ave., attending Illinois Institute of Technology.

184-82 Raymond G. Duesing (Rein.), Engineer (Elect'l.), Neiler, Rich & Bladen, 431 S. Dearborn St.

193-82 Harry L. Newman (Trsf.), Plant Superintendent, Precision Manufacturing Co., 829 Chicago Ave., Evanston, Ill.

194-82 Walter E. Friesser, Mechanical Engineer, Freyn Engineering Co., 29 E. Madison St.

195-82 Donald G. Burkhart, 949 N. Lorel Ave.,—attending Illinois Institute of Technology.

196-82 Harvey G. Chapin, Application Engineer, Westerlin & Campbell Co., 185 N. Wabash Ave.

197-82 Sammuel Cluts, Jr., Design Draftsman, Freyn Engineering Co., Dept. of Koppers, 109 N. Wabash Ave.

198-82 Fred Mamett (Trsf.), Electrical Designer, Freyn Engineering Co., Dept. of Koppers Co., Inc., 109 N. Wabash Ave.

199-82 Raymond Lobbes, Architectural Checker, Childs & Smith, 20 N. Wacker Dr.

200-82 Donald A. Walsh (Trsf.), Eng. Draftsman, New York Central Railroad, LaSalle Street Station.

201-82 Richard N. Congreve (Trsf.), Engineer, Container Corporation of America, 404 E. North Water St.

202-82 Frank D. Sammons, Jr. (Trsf.), Technician, University of Chicago, Inc. Nuc. Stud., 5801 S. Ellis Ave.

203-82 Edward G. Welling, Engineering Draftsman, Laclede Arch Co., 5 S. Wabash Ave.

204-82 Martin D. Peterson, Assistant Chem. Engineer, Underwriters' Laboratories, Inc., 207 E. Ohio St.

205-82 William E. Clark (Trsf.), Mechanical Engineer, Northern Indiana Public Service Co., Generating Station, Michigan City, Ind.

206-82 Peter Ziroli, Designer-Draftsman, J. W. Bagnuolo & Assoc., 221 N. La Salle St.

207-82 Randall W. Johnson (Trsf.), Office Engineer, Portland Cement Association, 33 W. Grand Ave.

208-82 Ira E. Graham (Trsf.), Safety Engineer, Employers Mutuals of Wausau, 228 N. La Salle St.

Final Nominations for Directors of WSE Section - Division - Council

The Nominating Committee of the Fire Protection and Safety Engineering Section has nominated two members as the regular ticket for Directors of this section, for a term of three years beginning June 1, 1951.

Nominees for the Fire Protection and Safety Engineering Section are:

Charles Engler, assistant to insurance and loss prevention manager, Montgomery, Ward & Co.

William A. Finger, hydraulic engineer, Marsh & McLennan, Inc.

The Nominating Committee of the Junior Division has slated the two following members as Directors:

Theodore W. Van Zelst, president, Soil Testing Services

Elliott A. Johnson, engineer, Helmco, Inc.

The Nominating Committee of the Women's Council has nominated four women members as Directors of the Council.

Nominees are as follows:

Catherine W. Eiden, engineer, Illinois Bell Telephone Co.

Terry Glenn, engineer, Yeomans Bros. Co.

Beatrice C. Horneman, landscape architect, Public Housing Authority

Ruth H. Perkins, architect, Bertram A. Weber.

Other Corporate Members may be nominated by petition signed by ten Corporate Members of the Society, provided acceptance of these nominees has been secured in writing.

The Bookshelf

Books Available at WSE Headquarters

Revised Mechanical Handbook

Mechanical Engineers Handbook, edited by Lionel S. Marks. McGraw-Hill Book Company, Incorporated, New York, N. Y. Fifth edition 1951, 2,236 pages. $15.00.

Nearly 300,000 copies of this famous handbook have been printed; the first edition came from the press in 1916. The fifth edition is completely new, revised, expanded, reset, and printed in the larger format already used for several other handbooks in this publishers modern handbook series. With the new large page, replacing the former pocket-book size, it has been possible to include about one-third more material in approximately the same number of pages as the previous edition.

More than 100 engineers, all specialists in their respective lines, cooperated in preparation of the fifth edition of this book. New developments and new products have been numerous and important during and since World War II. Theory, processes, materials, and power, all have felt the force of change. Among the many affected items, which either are new or radically changed in the fifth edition, are aerodynamics, jet propulsion, radar, television, radiant heating, statistical quality control, superalloys, plastics, silicones, powder metallurgy, gas turbines, and atomic power.

This book is divided into 16 numbered sections, the same as the previous edition, but inspection of the contents shows a longer list of general subjects. The index contains more than 12,000 entries, which the publishers claim makes it one of the fullest and most useful indexes that has been published in any technical book.

H. H. F., W.S.E.

Note: The trade edition is $15.00. A so-called textbook edition (in buckram binding) is being sold only through college bookstores at $12.50. Our reviews are always confined to the trade edition.

Electric Lighting Principles

Electric Illumination, by J. O. Kraehenbuehl. John Wiley & Sons, Incorporated, New York, N. Y., second edition, 1951. 446 pages. $8.00.

This book is concerned with adequate and safe lighting installations for commercial and industrial buildings. It presents the principles of specification and design of such installations for the education and guidance of architects and engineers. It also places in their hands a large quantity of highly specialized information on the technique of proper illumination. While it contains much tabular and illustrative material, it also directs the users to much more detailed information in numerous books and papers listed in the 13 bibliographies noted below.

The second edition has been expanded to cover the broadening of the field, and the new types of light sources made available since 1942. Thus there now are included the calculations of illumination from line and surface sources, and louverall lighting systems. The rapid progress of recent years has also brought about a complete new approach to the economics of proper illumination. There is now also an appendix which shows how engineers experienced in calculus can use it advantageously for some of their quantitative calculations.

Certain specialties like floodlighting and novelty lighting have been given considerable space, due to demands on the author for more guidance on these intricate and involved types of installations. Each of the 13 chapters is generally supplemented by both problems and a specialized bibliography.

Since 1922 the author has been on the faculty of the University of Illinois, where he is professor of electrical engineering. In addition to his academic work, he has engaged in considerable industrial work, and served as a technical consultant, so that he brings a distinct practical aspect into his literary work where he has credit for many technical papers and books.

H. H. F., W.S.E.

Thorough Hydraulics Reference

Engineering Hydraulics, edited by Hunter Rouse, published by John Wiley & Sons, Inc., New York, 1950. 1,039 pages. $15.00.

The Fourth Hydraulic Conference held at Iowa Institute of Hydraulic Research, located at the University of Iowa, arranged for group sessions with specialists in hydraulic fields. The purpose was to bring about the publication of a complete book on hydraulic engineering subjects in this country. Similar books in foreign languages emphasized the inadequacy of our technical literature in this field. *Engineering Hydraulics* is the direct result of these conferences. This book should supply a need long felt.

In this volume the combined efforts of more than a dozen men as the authors, together with the critical reviews from scores of others, has produced a volume that is based primarily on fundamental concepts. Other writers have often relied on engineering experience or laboratory investigations but the application of fundamental concepts is the dominant principle applied herein.

The thirteen chapters of the book, each authored by a different individual who is an expert in his particular field, provide basic knowledge for the solution of most hydraulic problems. These range from flow in underground and surface channels to hydraulic machinery.

The liberal use of bibliographies at the end of each chapter provides a ready reference to other source material.

The Bookshelf

Books Available at WSE Headquarters

It would appear that most of the problems of the hydraulic engineer are included within its covers. The chapter on engineering hydrology concerns the use of water as it comes from the clouds and its flow back to the sea. Storms, floods, flood routing and related problems are covered. Stream channels and their preservation are discussed in other chapters. There are discussions of pipe problems, surges and water hammer, wave action, sedimentation, flow measurements and model testing, all as related to the work of the Hydraulic Engineer.

If the engineer is looking for simple easy formulas to apply to his problem for a quick solution, he will not find them here. The specific aim has been to present a clear and comprehensive treatment of the subjects for ready reference and basic analysis. The editor in the preface states, "Although the volume may well be used in many graduate courses, and although it most assuredly contains a wealth of factual information, its primary purpose is not that of either a textbook or a handbook."

C. J. M., W.S.E.

New Time-Motion Study Ideas

Dynamic Motion and Time Study, by James J. Gillespie Chemical Publishing Co., Inc., Brooklyn, New York, 1951. 140 pages. $3.75.

This stimulating little text, by a British management consultant, is the outline for a course of instruction in motion study. It probably is intended for private instruction or in-plant training, as the author does not claim a connection with any university. According to the author, motion study is all controlling, since, when work motions are properly joined and correlated, the natural rhythm of each person's bodily movement will control the time interval for each complete motion, and very satisfactory outputs of good quality products may be expected.

For the almost discarded stop-watch, he would substitute physiology and psychology. In the first chapter he introduces his concept of Work Psychodynamics, which is further explained in the last four chapters, particularly in the final one. In support of his concept, he draws freely on the works of doctors and psychologists, such as Alexander, Dewey, Dunbar, Adler, Freud, Jung, and Reich.

To some industrial engineers, the author may appear as a dissenter from orthodox methods, since he would discard most parts of the older systems constructed by men like Gilbreth and Bedaux, whose systems he finds rather too atomistic, mechanistic, and restrictive of the worker, i. e. not designed to elicit true cooperative response and thus falling short of optimum results.

To other industrial engineers, the author may appear as a very progressive individual, promoting a forward-looking theory which ultimately may develop into a new art that will give better, more stable, and more satisfactory results, both in industrial relations and in product output.

H. H. F., W.S.E.

Technical Data on Hydrology

Applied Hydrology by Linsley, Kohler and Paulhus. McGraw-Hill Book Co. Civil Engineering Series, 1949, 689 pages. $8.50.

This is a text and reference book by three members of ASCE with important positions in the U. S. Weather Bureau. The sections on weather are unusually informative and are an excellent background for studies and data on rainfall and run-off.

Much unusual data is collected here on such subjects as evaporation, soil transportation of water, use and retention of water by various forms of vegetation, etc.

There are many tables, charts, and maps furnishing data on storms, amounts and intensities of precipitation, studies of overland flow, underground flow, hydrograph analyses, frequency, flood routing, and methods of computing run-off such as Sherman's unit - hydrograph method.

In spite of extremely technical treatment of the subject matter, the authors have been careful to include fundamental definitions. The book is well prepared, and is a valuable reference work.

R. I. M., W.S.E.

Communications Frequency Text

Electromagnetic Waves and Radiating Systems, by Edward C. Jordan. Prentice-Hall, Inc., New York, 1950. 710 pages. $10.50.

This text, intended for senior level engineering students, covers communications-frequency theory and application. Roughly one half of the book is devoted to the usual foundation theory, starting with vector analysis and proceeding through electric and magnetic static fields to electromagnetic waves. This is followed by chapters on guided waves, wave guides and transmission lines.

The latter half of the book deals with radiation and propagation phenomena, and covers such topics as directional properties of antennas, antenna impedance, antenna practice and design, aperture antennas, and sky and ground wave propagation. This section of the book will be of principal interest to engineers because of its extensive treatment of these subjects.

W. F. L., W.S.E.

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